# Task 3.2

## Quarterly Status Report # 7

*for the project entitled*

# Dairy Best Available Technologies in the Okeechobee Basin

**(SFWMD Contract No. C-11652)**

*Submitted by*

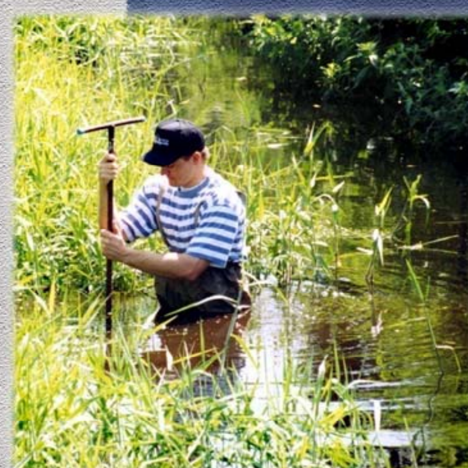
# SWET, Inc.

## Soil and Water Engineering Technology, Inc.

*In Association With*

**MOCK•ROOS**
**CH2M HILL**
**ENTEL**

**December 28, 2005**



The SWET Team

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Royal Consulting Services, Inc.
**ENTEL Environmental Companies, Inc.**


Revised
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## Introduction

This is the seventh status report for the Dairy Best Available Technologies (BAT) project. This report covers the four quarters from October 1, 2004 through September 30, 2005. The primary activities during this period have been the construction of the Milking R Dairy edge-of-farm treatment system, conducting routine monitoring of three existing treatment systems, and development of the draft monitoring plan for Milking R. Table 1 shows the status of each individual task.

## Monitoring Activities and Problems Encountered

Monitoring during the period has focused on the seven treatment monitoring sites. Most of these sites have recorded flows and stages and collected samples properly with a few notable exceptions. As noted in the previous status reports, flow measurement at sites Davie Tin and Dry Lake Tmid and Tout has been continued to be hampered by the lack of sensitivity of the velocity meters due to clear water conditions. The filtering processing continues to work well for adjusting these data.. However, during this period the primary monitoring problem have been associated with equipment failure, general equipment maintenance problems, and inflow grab samples were being collected in the wrong location until 9/15/05.

The specific problems during the period were wire corrosion and solar panel failure at Dry Lake TIN (down from 1/15/05 till 2/18/05). Butler TOUT automatic sampler stage offset parameter was incorrectly set resulting in no samples being collected during June and July 2005, however the stage could be manually corrected for flow estimates. Grab samples were collected as a backup during this period. At Davie Dairy all was well until on 11/9/04 the pond outlet culvert floated out of position, which destroyed the sampling equipment at the site. This occurred due to a safety response to a chemical over-injection event that occurred on 10/31/04. When the landowner discovered the problem on 11/3/04 a decision was made to place extra boards into the TOUT culverts to prevent any of the excess chemical from leaving the flocculation pond. Davie TOUT was out of service until 2/15/05 because of pond remediation. Then on 3/29/05 the stage readings for Davie TOUT started to have drift problems, so the transducer was replaced in June. The second transducer had similar problems, but it was thought that the drift problems could be manually corrected in the data. However, upon review processing it was discovered that the stage data were not just drifting, but were erroneous and could not be corrected. However, the TIN could be used because for the Davie pass-thru flocculation pond the flows into and out of the pond are always about the same. The TIN data were consistent during this period, but the stage data during periods of high flow and when the inlet culvert was submerged had to be corrected for an entrance vortex effect as is discussed in the next session. The transducer at TOUT was replaced again on October 12, 2005.

The treatment inflow grabs samples for Butler and Davie Dairies' systems were incorrectly collected in the flocculation ponds near the inflow culvert or pumps' discharge. Therefore, these inflow samples were downstream of the chemical injection point, which meant they do not represent the untreated inflow to the systems. This error

Table 1. Task Status for Dairy BAT Project

| TASK / DELIVERABLES DESCRIPTION | COMPLETION DATE | STATUS |
|---|---|---|
| **Development of Goals, Performance Measures and Potential Impacts** | | |
| 1.1 Project Kick-Off Meeting | 11/9/2000 | Completed |
| 1.2 Develop Draft Goals, Potential Impacts/Performance Measures and Evaluation Method | 12/2/2000 | Completed |
| 1.3 Conduct and Submit Literature/Data Search and Summary | 1/2/2001 | Completed |
| 1.4 Submit Final Goals, Potential Impacts/Performance Measure and Evaluation Method | 2/2/2001 | Completed |
| **Assessment and Selection of Project Sites** | | |
| 2.1 Ranking and Selection of Dairy Sites | 2/2/2001 | Completed |
| 2.2 Development of Landowner Agreements | 4/2/2001 | Completed |
| 2.3 Develop and Submit Draft QAPP and Monitoring Plans | 6/2/2001 | Completed |
| 2.4 Formulate Technology Alternatives and Submit Draft Report | 6/2/2001 | Completed |
| 2.5 Finalize and Submit Final QAPP and Monitoring Plans for Existing Dairy Conditions | 8/2/2001 | Completed |
| 2.6 Finalize Technology Alternatives and Submit Final Report | 8/2/2001 | Completed |
| 2.7 Complete Evaluation of Alternatives and Submit Draft Report | 9/2/2001 | Completed |
| 2.8 Develop and Submit Draft CNMPs for the Three Selected Dairies | 10/2/2001 | Completed |
| 2.9 Prepare for and Conduct One Stakeholders Meeting | 10/2/2001 | Completed |
| 2.10 Finalize the Evaluation of Alternatives and Submit Final Report | 11/2/2001 | Completed |
| 2.11 Finalize the CNMPs for the Three Selected Dairies and Submit Final Report | 11/2/2001 | Completed |
| 2.12 Governing Board Presentation | 11/2/2001 | Completed |
| **Implementation and Monitoring of Alternatives** | | |
| 3.1 Farm Level P Load Monitoring | | |
| 3.1.1 Equipment purchase (up to a total of 9 sites) | 11/2/2001 | Completed |
| 3.1.2 Install and Test Monitoring Stations (9 stations assumed) | 11/2/2001 | Completed |
| 3.1.3 Conduct Routine Field Monitoring Activities - TP (52 Biweekly trips from RPB) | 11/2/2001 | Started 5/1/02 |
| 3.1.4 Laboratory Analyses (assume 9 biweekly samples for 52 trips TP @$15/sam.)* | 1/2/2002 | Started 5/1/02 |
| 3.1.5 Labor & Lab for 9 monthly samples for 24 mo. Fecal and TSS @ $45/sample * | 1/2/2002 | Started June, 2002 |
| 3.2 Preparation and Submittal of Quarterly Reports | 11/2/2001 | Phase I Completed |
| 3.2.A Amendment No. 1 | 1/15/2004 | Quarters 1,2,&3 submitted |
| 3.3 Develop Draft Vendor Project Documents | 1/2/2002 | Completed |
| 3.3.A Amendment No. 1 | 7/2/2003 | Completed |
| 3.4 Finalize Vendor Project Documents | 3/2/2002 | Completed |
| 3.4.A Amendment No. 1 | 8/1/2003 | Completed |

| | | |
|---|---|---|
| 3.5 Draft Implementation Plan for Selected Technologies | 3/2/2002 | Completed |
| 3.5.A Amendment No. 1 | 3/1/2004 | Completed |
| 3.6 Draft Monitoring Plan for Selected Technologies | 3/2/2002 | Completed |
| 3.6.A Amendment No. 1 | 2/1/2004 | Completed |
| 3.7 Development of the Final Implementation Plan for Selected Technologies | 5/2/2002 | Completed |
| 3.7.A Amendment No. 1 | 5/1/2004 | Completed |
| 3.71 Cost of Implementing Vendor Technology | 5/2/2002 | Completed |
| 3.7.1.A Amendment No. 1 | 5/1/2004 | Completed |
| 3.72 Review and Inspect Vendor Construction Activities | 5/2/2002 | Completed |
| 3.7.2.A Amendment No. 1 | 5/1/2004 | In Process |
| 3.7.3 Vendor Payments | 5/2/2002 | 3 Complete,RCS in process |
| 3.8 Final Monitoring Plan for Selected Technologies | 5/2/2002 | Completed |
| 3.8.A Amendment No. 1 | 3/1/2004 | In Review |
| 3.8.1 Equipment Purchase (up to a total of 6 sites) | 6/2/2002 | Completed |
| 3.8.1.A Amendment No. 1 | 3/1/2004 | In Process |
| 3.8.2 Install and Test Monitoring Stations | 6/2/2002 | Completed |
| 3.8.2.A Amendment No. 1 | 5/1/2004 | In Process |
| 3.8.3 Conduct Routine Monitoring Activities - TP | 8/2/2002 | In Process |
| 3.8.3.A Amendment No. 1 | 5/1/2004 | To be scheduled |
| 3.8.4 Laboratory Analyses TP | 8/2/2002 | In Process |
| 3.8.4.A Amendment No. 1 | 5/1/2004 | To be scheduled |
| 3.8.5.A Lab. Analyses for 3 samp/mo for 15 mo, fecal and TSS | 12/1/2005 | To be scheduled |
| 3.9 Prepare for and Attend Bi-annual Site Meeting (5 qtrs) | 8/2/2002 | 1 Meeting during period |
| 3.9.A Amendment No. 1 | 8/2/2004 | To be scheduled |
| 3.10 Prepare for and Conduct Public Workshop | 11/2/2002 | To be scheduled |
| 3.11 Submit Workshop Minutes | 12/2/2002 | To be scheduled |
| **Evaluation of Alternatives Performance** | | |
| 4.1 Prepare and Submit Draft Final Report | 9/2/2003 | To be scheduled |
| 4.2 Prepare for and Conduct Public Workshop | 10/2/2003 | To be scheduled |
| 4.3 Prepare and Submit Final Report and Associated Project Data | 11/2/2003 | To be scheduled |
| 4.4 Prepare and Submit Workshop Minutes | 11/2/2003 | To be scheduled |

was not discovered until September, 2005, so only TIN grabs after September 15, 2005 are useful and all grabs before this date were disregarded. Therefore, estimates for inflow concentrations prior to September 15, 2005 could only be based on automatic sampler data at these sites.

The final monitoring activity during the period was the development of the draft monitoring plan for the new Milking R system (Task 3.6.A), dated July 11, 2005. Three new treatment sites are purposed for the system in a similar fashion as Dry Lake's system, i.e. TIN at the lift pumps to retention pond, TMID discharge culvert from retention pond to chemical treatment flocculation pond, and TOUT at the outflow culvert of the flocculation pond (see Appendix A).

## Analysis of Flow and Water Quality Data

The flow and water quality data for the monitoring sites has been analyzed (see Appendix B data plots). Table 2 provides an overall summary of the estimated flow and phosphorus loads from the sites through the end of the reporting period. Table 3 provides an additional breakdown of the flow and P loads data for the various monitoring locations. As previously noted, the estimated flow volumes are subject to error. All sites were functional during this reporting period with the exceptions noted in the previous section. In spite of the fact that none of the sites were fully operational during the entire period of record, data from other sites and grabs samples were available to reasonably estimate flows and loads through the sites. Table 2 clearly shows significant reductions were achieved. For Dry Lake and Butler a large part of the P load reduction was due to water retention and reuse. Estimates were made for the P removal efficiencies for the three systems for just the periods when the systems were known to be fully operational (Table 4). Please note that the values in Table 4 only reflect P concentration reductions observed for the treatment systems and therefore do not include any water retention and reuse reductions during the same periods. As seen in Table 4, P reductions for the treatment systems were typically over 80% with the exception of Davie, which might be biased by carry over from non-treatment periods due to the high retention times for the flocculation pond. The treatment efficiency at Butler is subject to the most error because inflow concentrations were incorrectly sampled due to the grabs being drawn from the wrong location. However, the limited composited samples from autosamplers clearly indicate relatively high inflow concentrations, which were used in this assessment. Dry Lake most clearly shows the effect of alum injection rate on treatment efficiency. Direct measurements of chemical concentrations were not obtained for the other two sites, but were estimated based on chemical usage and flow.

The entered water quality data and downloaded velocity and depth data were processed through the EXCEL data management spreadsheet which checks the QC samples and calculates the flow and P loads. The spreadsheet plots all the data for a visual inspection and validation. An important data management function of cleaning the very noisy velocity data is performed in the spreadsheet. The filtering process includes using a stage

**Table 2. Summary of P Reductions for Dairy BAT Project to Date**

| Dairy Name | P Load Reduction | | % Due To |
|---|---|---|---|
| | Load (lb) | % | Reuse/Retention |
| Davie Dairy | 5580 | 25.8% | 5.2% |
| Butler Oaks Dairy | 11383 | 77.8% | 81.4% |
| Dry Lake Dairy | 6847 | 53.7% | 82.8% |
| **Total** | 23810 | 48.6% | 64.0% |

**Table 3. Summary of Flow and P Concentration Data for Dairy BAT Treatment Monitoring Sites**

| **Dairy Name** | **Davie Dairy** | | | | | |
|---|---|---|---|---|---|---|
| Site Name | Land Flow | Retained/Reuse | ByPassed | Tin | Tout | |
| Volume (ac-in) | 92500 | 1250 | 46431 | 46073 | 47223 | |
| Runoff (in) | 37 | 0.5 | 18.6 | 18.43 | 18.89 | |
| Runoff (in/yr) | 19.3 | 0.3 | 9.7 | 9.61 | 10.35 | |
| Area (ac) | 2500 | 2500 | 2500 | 2500 | 2500 | |
| P load (lbs) | 21602 | 292 | 10843 | 8584 | 5179 | |
| P load (lbs/yr) | 11265 | 152 | 5655 | 4477 | 2837 | |
| Flow Avg P (ppm) | 1.01 | 1.01 | 1.01 | 0.82 | 0.48 | |
| Years of Data | 1.92 | 1.92 | 1.92 | 1.92 | 1.83 | |
| Start Date | 10/1/03 | 10/1/03 | 10/1/03 | 10/1/03 | 11/3/03 | |
| End Date | 8/30/05 | 8/30/05 | 8/30/05 | 8/30/05 | 8/30/05 | |
| **Dairy Name** | **Butler Oaks Dairy** | | | | | |
| Site Name | Land Flow | Retained/Reuse | ByPassed | Tin | Tout | |
| Volume (ac-in) | 15750 | 9973 | 2625 | 3153 | 3153 | |
| Runoff (in) | 30 | 19.00 | 5.00 | 6.00 | 6.00 | |
| Runoff (in/yr) | 22.8 | 14.4 | 3.8 | 4.56 | 4.56 | |
| Area (ac) | 525 | 525 | 525 | 525 | 525 | |
| P load (lbs) | 14636 | 9267 | 2439 | 1524 | 814 | |
| P load (lbs/yr) | 11121 | 7042 | 1854 | 1158 | 618 | |
| Flow Avg P (ppm) | 4.00 | 4.00 | 4.00 | 2.13 | 1.14 | |
| Years of Data | 1.32 | 1.32 | 1.32 | 1.32 | 1.32 | |
| Start Date | 3/19/04 | 3/19/04 | 3/19/04 | 3/19/04 | 3/19/04 | |
| End Date | 7/13/05 | 7/13/05 | 7/13/05 | 7/13/05 | 7/13/05 | |
| **Dairy Name** | **Dry Lake Dairy** | | | | | |
| Site Name | Land Flow | Retained/Reuse | ByPassed | Tin | Tmid | Tout |
| Volume (ac-in) | 19080 | 8487 | 8827 | 9673 | 1766 | 1375 |
| Runoff (in) | 36 | 16.0 | 16.7 | 19.34 | 3.33 | 2.59 |
| Runoff (in/yr) | 24.8 | 11.0 | 11.5 | 13.33 | 2.30 | 1.74 |
| Area (ac) | 530 | 530 | 530 | 500 | 530 | 530 |
| P load (lbs) | 12743 | 5668 | 5895 | 12488 | 1421 | 415 |
| P load (lbs/yr) | 8778 | 3905 | 4061 | 8603 | 980 | 278 |
| Flow Avg P (ppm) | 2.87 | 2.87 | 2.87 | 5.70 | 3.55 | 1.33 |
| Years of Data | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 | 1.49 |
| Start Date | 3/19/04 | 3/19/04 | 3/19/04 | 3/19/04 | 3/19/04 | 3/3/04 |
| End Date | 8/31/05 | 8/31/05 | 8/31/05 | 8/31/05 | 8/30/05 | 8/30/05 |

Table 4. The estimated treatment efficiency of the three Dairy BAT systems during period of operation.

| Butler Dairy | | | Davie Dairy | | | Dry Lake Dairy | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Inflow | Outflow | Reduction | Inflow | Outflow | Reduction | Release | Al conc. | Inflow | Outflow | Reduction |
| mg/l | mg/l | | mg/l | mg/l | | | mg/l | mg/l | mg/l | |
| 4 | 0.54 | 87% | 0.99 | 0.33 | 67% | 1 | 35* | 5 | 0.077 | 98% |
| 1.5 | 0.34 | 77% | | | | 2 | 10.7 | 4.9 | 2.05 | 58% |
| | | | | | | 3 | 25.1 | 2.5 | 0.29 | 88% |
| | | | | | | 4 | 27.5 | 2.9 | 0.52 | 82% |

*** Estimated from chemical use, not directly measured**

to velocity relationship developed from data from stable periods of record to fill velocity data gaps when stage is available. During noisy periods a moving average of the maximum velocity values is used because most of the noise is caused by the clean water conditions dropping signal levels to zero or below. The velocity adjustment obviously only needed to be done for the three sites that use these transducers. Because of datum drifts, missing and poor data, other data adjustment techniques had to be used. For example, it was clear from the Butler TOUT stage data that its reference datum was being reset incorrectly in the ISCO sampler on several occasions during this past summer. These weir crest offset adjustments had to be corrected by hand based on the visual review of the stage data, which clearly shows the crest height when the pond reaches equilibrium after a pump cycle. Also, at Davie TOUT the transducer was bad most of this past summer in spite having been replaced once in mid June. Therefore, the inflow stage measured at Davie TIN, which also represents the pond water level, was used instead during the period of bad stage data at Davie TOUT. However, before the TIN stage could be used it had to be corrected because it was discovered that during periods of high flow, as verified by the flow meter on the chemical injection system, the stage readings at TIN would drop proportionally as the flow rate increased. This is believed to be due to the vortex-effect occurring at the culvert entrance, which can cause a negative pressure as the flow streamlines converge. A negative correlation was found between the injection system flowmeter readings and TIN stage. A correction algorithm was developed to correct stages when this effect was occurring using the flowmeter data. The corrections provided reasonable stage and flow measures as seen in Figure B1 and B3. This technique was considered good because during periods where both Davie TIN and TOUT stages were being recorded, the flow estimates matched well. Because of the different flow measurement techniques for the TIN and TOUT data, some differences in estimated accumulative flows are present, but are within a reasonable error.

The phosphorus data are presented on the flow plots Figures (B-3 to B-20) to show how the phosphorus concentrations relate to flow. Please note that the flat concentration line in these figures show the TP concentration from the date the composite sample was collected back to the date of the previously collected sample. This was done for estimating flow and graphical purposes, but in reality most composite samples were collected within 28 days (maximum holding time for TP) of the first subsample into the composite bottle. Where flat lines extend over 28 days there were either no flow conditions earlier in the period or flow was present and was not sampled due to sampler equipment failures. This means that the phosphorus concentration used for load estimation was from the next available composite sample.

The equipment blanks (Table 5) analyzed as part of the quality assurance program were all below detectable limits during this reporting period except for the 7/19/05 sample, which was just above the detectable limit (0.01). The results from the duplicate samples during this reporting period were all within the 20 % acceptable range except for five samples, see Table 6.

Table 5. Equipment Blanks Analyses for Reporting period

| Site | Date | Time | Total P |
|---|---|---|---|
| | | | (mg/l) |
| #1 | 9/13/2004 | 10:15 | BDL |
| #1 | 9/30/2004 | 10:00 | BDL |
| #1 | 10/12/2004 | 10:55 | BDL |
| #1 | 10/18/2004 | 16:15 | BDL |
| #1 | 11/8/2004 | 8:30 | BDL |
| #1 | 12/14/2004 | 9:00 | BDL |
| #1 | 3/22/2005 | 9:30 | BDL |
| #1 | 3/30/2005 | 0:00 | BDL |
| #1 | 4/13/2005 | 9:35 | BDL |
| #1 | 5/11/2005 | 10:55 | BDL |
| #1 | 6/3/2005 | 10:10 | BDL |
| #1 | 6/17/2005 | 11:20 | BDL |
| #1 | 7/19/2005 | 8:55 | 0.020 |
| #1 | 8/14/2005 | 16:14 | BDL |
| #1 | 8/4/2005 | 0:00 | BDL |
| #1 | 8/18/2005 | 8:00 | BDL |
| #1 | 8/18/2005 | 10:50 | BDL |
| #1 | 9/8/2005 | 8:00 | BDL |

Table 6. Quality Assurance Results for the Duplicate Sampling where the acceptable range is 20%.

| Davie T-In | | Davie T-Out | | Butler T-In | | Dry Lake T-In | | Dry Lake T-Out | |
|---|---|---|---|---|---|---|---|---|---|
| Date | % Diff | Date | % Diff | Date | % Diff | Date | % Diff | Date | % Diff |
| 6/24/04 | 0.0% | 9/30/03 | 0.0% | 10/12/04 | -8.3% | 7/7/04 | -21.7% | 9/30/04 | -20.4% |
| 7/20/04 | -1.3% | 2/12/04 | 9.1% | 8/4/05 | 18.0% | | | 10/18/04 | 15.7% |
| 8/12/04 | -31.6% | 9/13/04 | -3.0% | | | | | | |
| | | 11/8/04 | 78.8% | | | | | | |
| | | 3/22/05 | 9.2% | | | | | | |
| | | 3/30/05 | -3.8% | | | | | | |
| | | 4/13/05 | 0.0% | | | | | | |
| | | 5/11/05 | -20.4% | | | | | | |
| | | 6/17/05 | 11.8% | | | | | | |
| | | 7/19/05 | -9.5% | | | | | | |
| | | 9/8/05 | 12.1% | | | | | | |

## Vendor and Construction Progress

The construction phases of the three initial dairy projects were completed prior to this reporting period, however, some equipment and maintenance problems did occur during the period that will be discussed in a later section.  The only construction activity during the period was for Amendment 1's Milking R project where construction started in April, 2005 and is anticipated to be completed by the end of December, 2005.  Construction was significantly delayed due to heavy rains that started in mid May and continued into July. In spite of the weather most of the ditch excavation and cleaning was completed during this period.  Much of the main reservoir dike work that was done prior to the wet period had to be reformed and graded.  The main dike has been completed and is in the process of being mulched and seeded .  The lift pumps to the retention pond are on site and being installed.  The other work to be completed at Milking R is the collection sump/pump system west of the old Bion System that will pump drainage water through the system's existing sheet flow treatment wetland and then flow to the lift pump at the retention pond. The substantial completion inspection is scheduled for the first week of December.  Table 7 provides a status of the design/build vendor expenditures to date, while Table 8 provides an updated task schedule for the next two quarters.

**Table 7. Invoiced Expenditures for Vendors through October1, 2005**

| Vendor Name | Percentage | Invoiced through October 1, 2005 |
|---|---|---|
| Engineering & Water Resources, Inc. | 100% | $574,996.28 |
| CDM | 100% | $575,000.00 |
| Environmental Research & Design | 100% | $574,041.26 |
| **AMENDMENT 1** | | |
| Royal Consulting Services, Inc | 89% | $510,161.06 |
| | **Total** | **$2,234,198.60** |

**Table 8. EOF Activities Schedule**

| Tasks | Schedule 2005/2006 | | | | | | |
|---|---|---|---|---|---|---|---|
| | Oct | Nov | Dec | Jan | Feb | March | April |
| **First Three Dairies** | | | | | | | |
| Monitoring Treatment Sites | | | | | | | |
| **Amendment 1 Dairy** | | | | | | | |
| Finish Construction | | | | | | | |
| System Startup and Testing | | | | | | | |
| Monitoring plan and Installation | | | | | | | |
| Monitoring Treatment Sites | | | | | | | |

## Operation and Maintenance of Three Completed EOF Systems

As anticipated, a number of equipment and other operation and maintenance issues have occurred since the three original EOF systems came on line last year. Table 9 provides a summary of the treatment system status and problems encountered for the three active Dairy BAT systems. As seen in Table 9, there has been significant periods of down time mostly due to equipment failures. It has been clear that higher quality injection pumps and more consistent equipment maintenance is going to be required to keep these systems operational.

Operation and maintenance problems have been addressed as a joint effort between the landowners, SWET, and the design/build engineering firms. As indicated in Table 9, most of the problems have been associated with the chemical injection systems and power failures at the lift pumps. At Davie Dairy the rotor and stator were found to be incompatible with the polymer chemical, so the pump manufacturer had to be brought in to recommend new materials for the pump. It has also been discovered that the polymer chemical at Davie can be unstable and congealed in the tanks. A new buffered chemical is being tested to replace this polymer. At Butler Dairy the pump control wiring was preventing the injection pumps from working properly and therefore had to be rewired. At Dry Lake the flowmeter in the alum injection line was found to clog due to crystallization between treatment periods, which blocked flow. To address this problem the flowmeter needs to be cleaned before each treatment cycle. The variable opening alum flow valve was also found to be unreliable and would not open sometimes, which caused injection pump failures. This was temporarily addressed by bypassing the valve and setting injection flowrates by hand. This actually worked fairly well because of the infrequent need for treatment events.

The pumps at Butler Dairy have been reliable except during power outages, which has been corrected by the landowner obtaining a large generator. The automatic start pump at Dry Lake initially had a start up problem due to an air leak in the fuel line. After the line was replaced it has started well, but the control system would periodically go out due to a fuse blowing within the control panel. Once replaced with an appropriate sized fuse the system has functioned reliably.

## Permitting Issues

All necessary permits have been received for all four dairy projects.

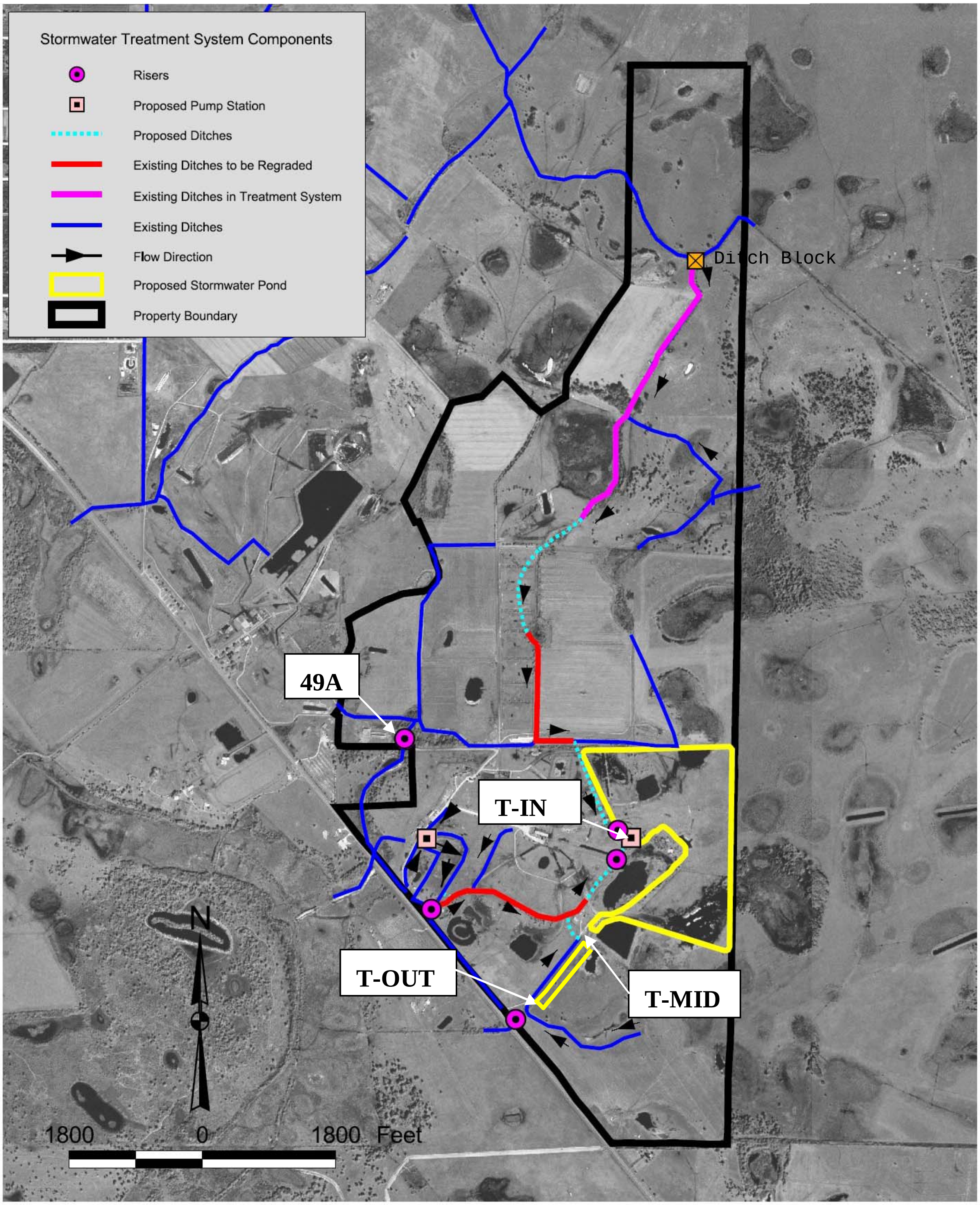
Table 9. Operational Status of Three Active Dairy BAT Systems

| Davie Dairy | | |
|---|---|---|
| **Date** | **Status** | **Comments** |
| 10/03 | Water diversion only | Chemical injection system no functional |
| 5/21/04 | Water diversion only | First chemical load delivered |
| 6/8/04 | Chemical injection On | Injection rate unstable |
| 8/16/04 | Water diversion only | Second chemical delivery, injector pump failure |
| 10/1/04 | Chemical injection On | Pump repaired and system turned on |
| 10/3/04 | Over injection discovered | Pump set wrong – pumped 3000gal into pond |
| 10/3/04 | System totally off line | Gates opened to bypass treatment pond |
| 2/25/05 | Water diversion only | Pond used for 1st time since over-injection remediation |
| 4/7/05 | Chemical injection On | Normal operation |
| 6/4/05 | Water diversion only | Ran out of chemical |
| 6/8/05 | Chemical injection On | Normal operation |
| 8/5/05 | Water diversion only | Injection pump failure |
| 9/5/05 | Chemical injection On | Normal operation |
| **Butler Dairy** | | |
| **Date** | **Status** | **Comments** |
| 3/04 | Pumps Operational | Pumped to waste storage pond for reuse |
| 9/1/04 | Off line | Bypass opened due to hurricane |
| 9/7/04 | Pumps Operational | First flow through flocc pond, but no chemicals |
| 9/27/04 | Pumps off for about 2 wks | Bypass boards pulled due to hurricane |
| 3/17/05 | Fully Operational | First chemical treatment |
| **Dry Lake Dairy** | | |
| **Date** | **Status** | **Comments** |
| 3/15/04 | Inflow Pump Operational | First pumpage to pond on 3/30/04 |
| 8/14/04 | Pump Off Line | Limited bypass water occurred |
| 8/18/04 | Pump Operational | |
| 9/5/04 | Pump Operation Intermittent | Significant bypass flow on 9/6, 9/21 & 9/27 |
| 9/20/04 | Pump Operation Intermittent | Discharge through floc pond – no treatment |
| 9/29/04 | Pump Operation Intermittent | Discharge through floc pond – no treatment |
| 10/14/04 | Pump Operation Intermittent | Discharge through floc pond – no treatment |
| 10/18/04 | 1st Chemical Treatment | Two-day alum treated release from pond |
| 10/21/04 | Pump Operational | No bypass water during period |
| 12/15/04 | 2nd Chemical Treatment | Two-day alum treated release from pond |
| 5//31/05 | Pump Non-Operational | Some bypass flow from 6/3 to 6/11 |
| 6/11/05 | Pump Operational | No bypass |
| 6/20/05 | Pump Non-Operational | Some bypass flow from 6/20 to 7/4 |
| 7/4/05 | Pump Operational | No bypass |
| 7/10/05 | Pump Operation Intermittent | Some bypass flow |
| 8/4/05 | 3rd Chemical Treatment | Two-day alum treated release from pond |
| 8/10/05 | Pump Operation Intermittent | Test discharge through floc pond – no treatment |
| 8/18/05 | 4th Chemical Treatment | Two-day alum treated release from pond |
| 9/22/05 | 5th Chemical Treatment | Two-day alum treated release from pond |
| 9/29/05 | 6th Chemical Treatment | Two-day alum treated release from pond |

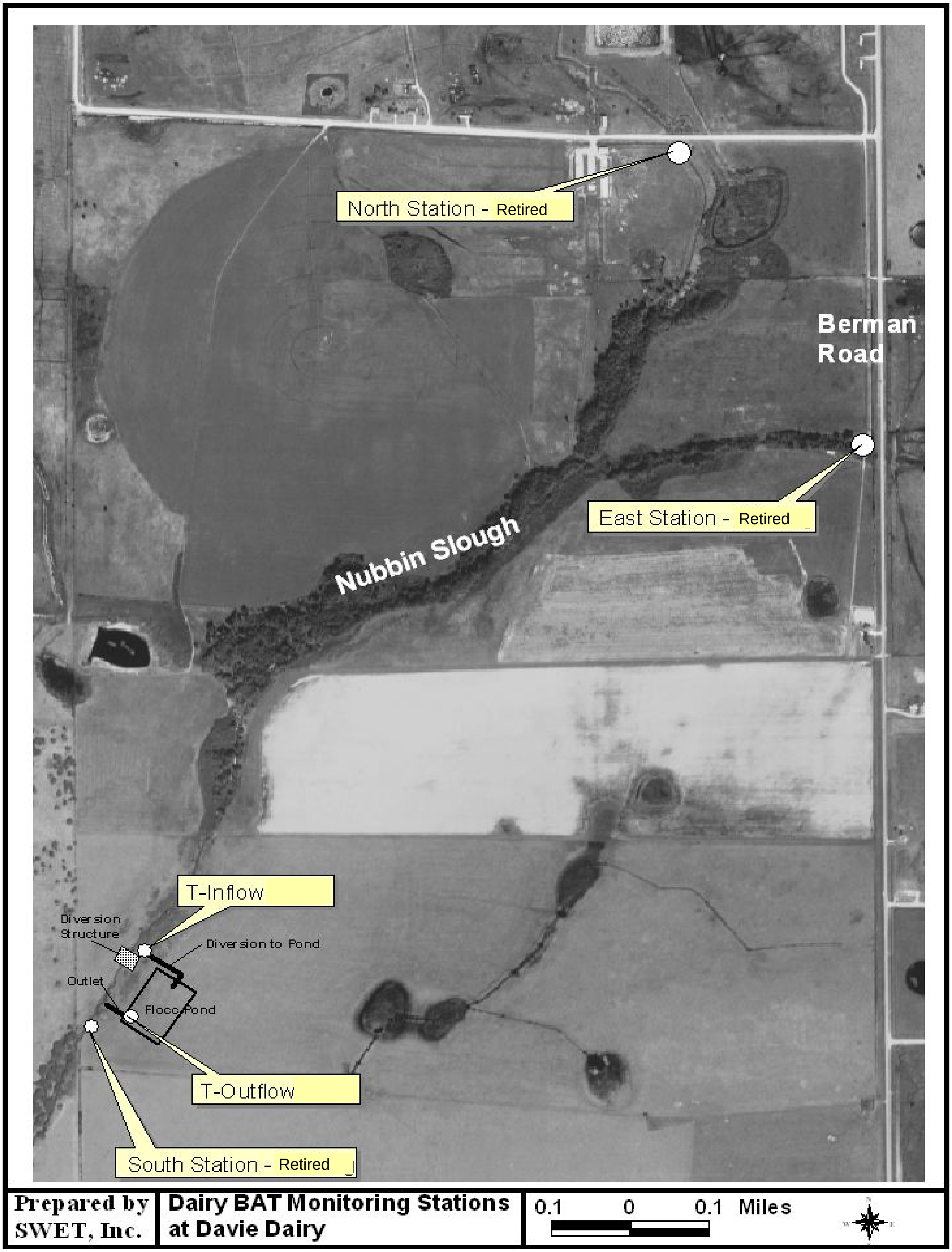
# APPENDIX A

# SITE MAP OF THE FOUR DAIRY BAT TREATMENT SYSTEMS WITH MONITORING LOCATIONS

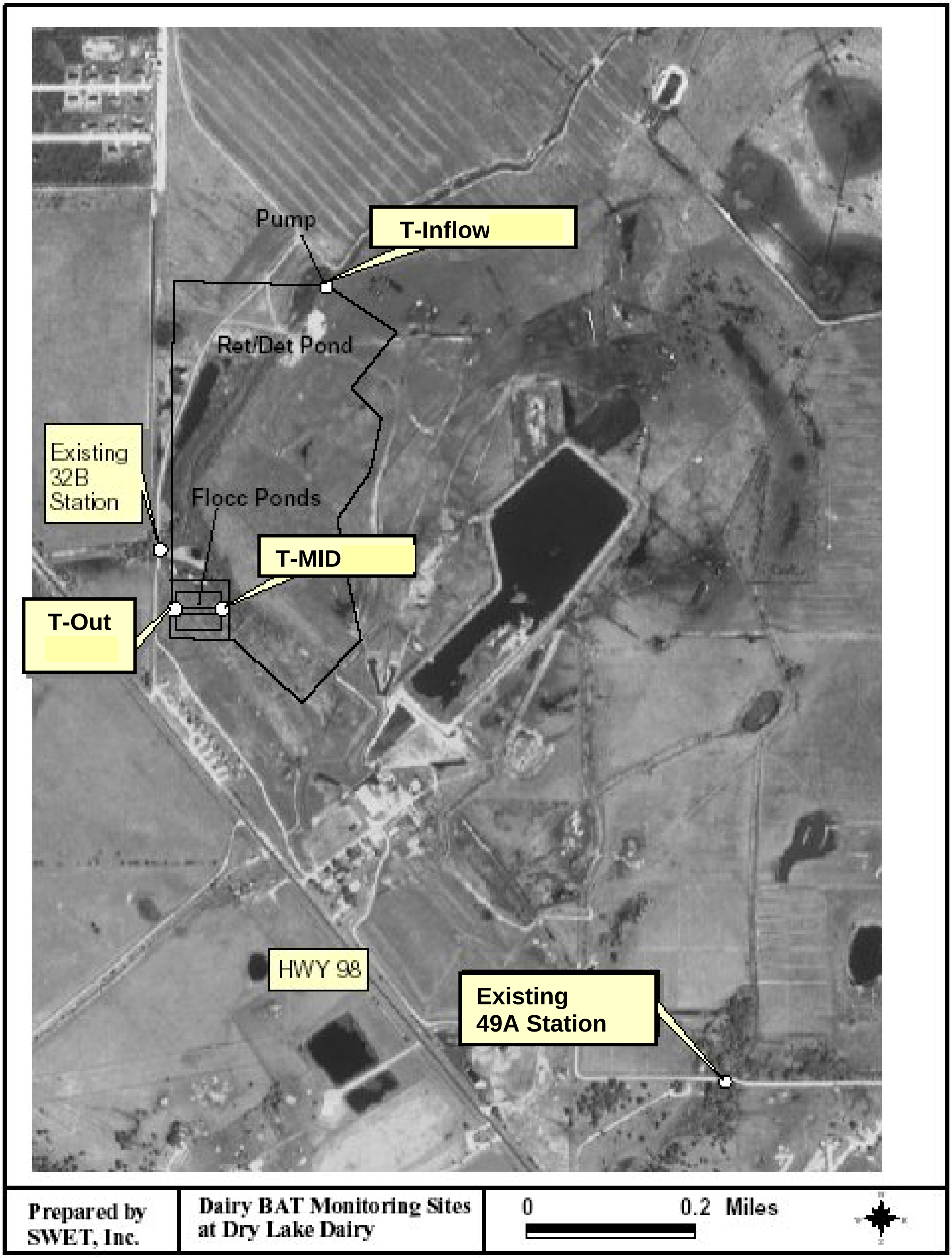
Map of Project Site (Milking R Dairy Inc.)



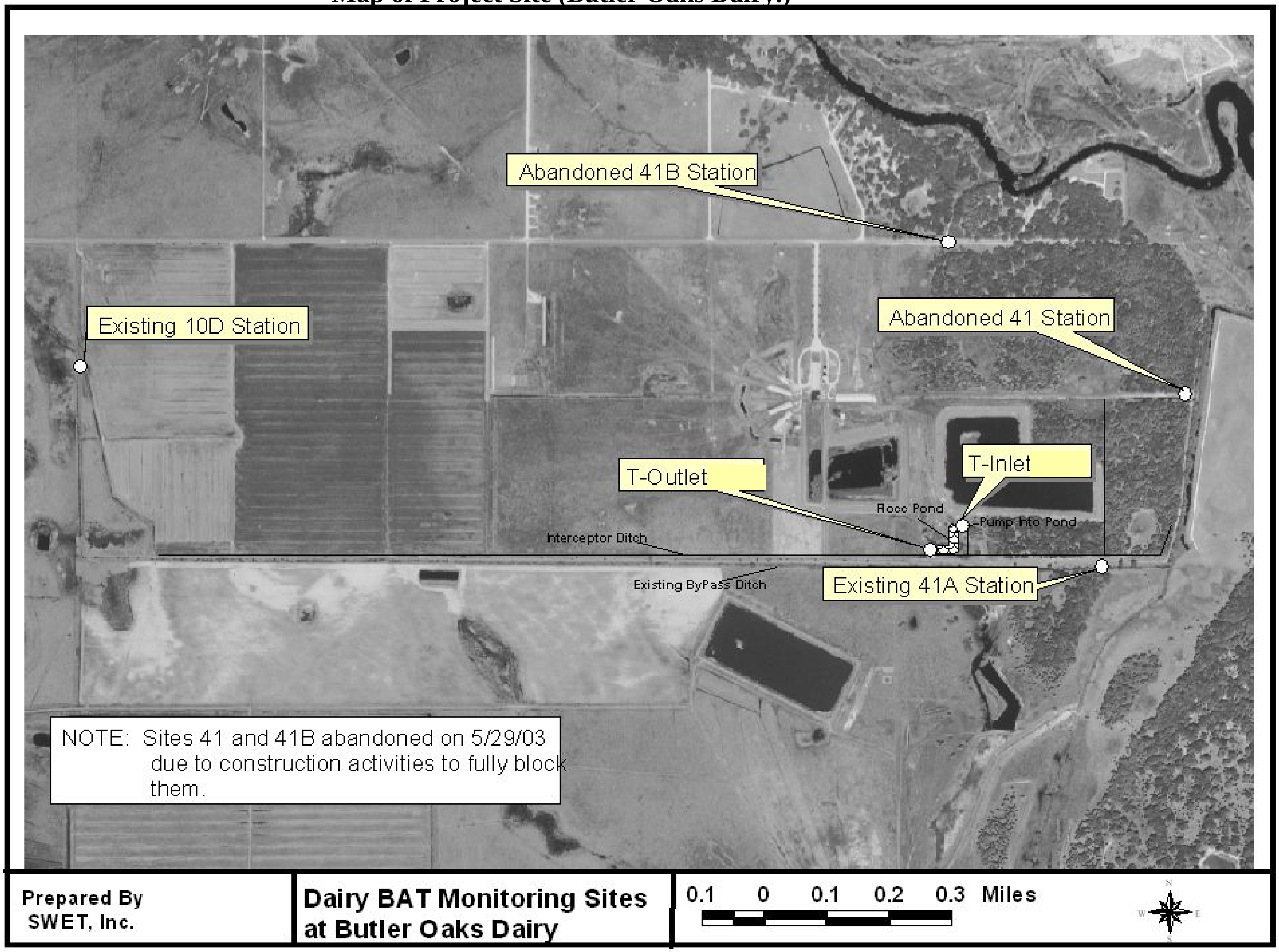
## Map of Project Site (Davie Dairy Inc.)



**Map of Project Site (Dry Lake Dairy.)**



## Map of Project Site (Butler Oaks Dairy.)

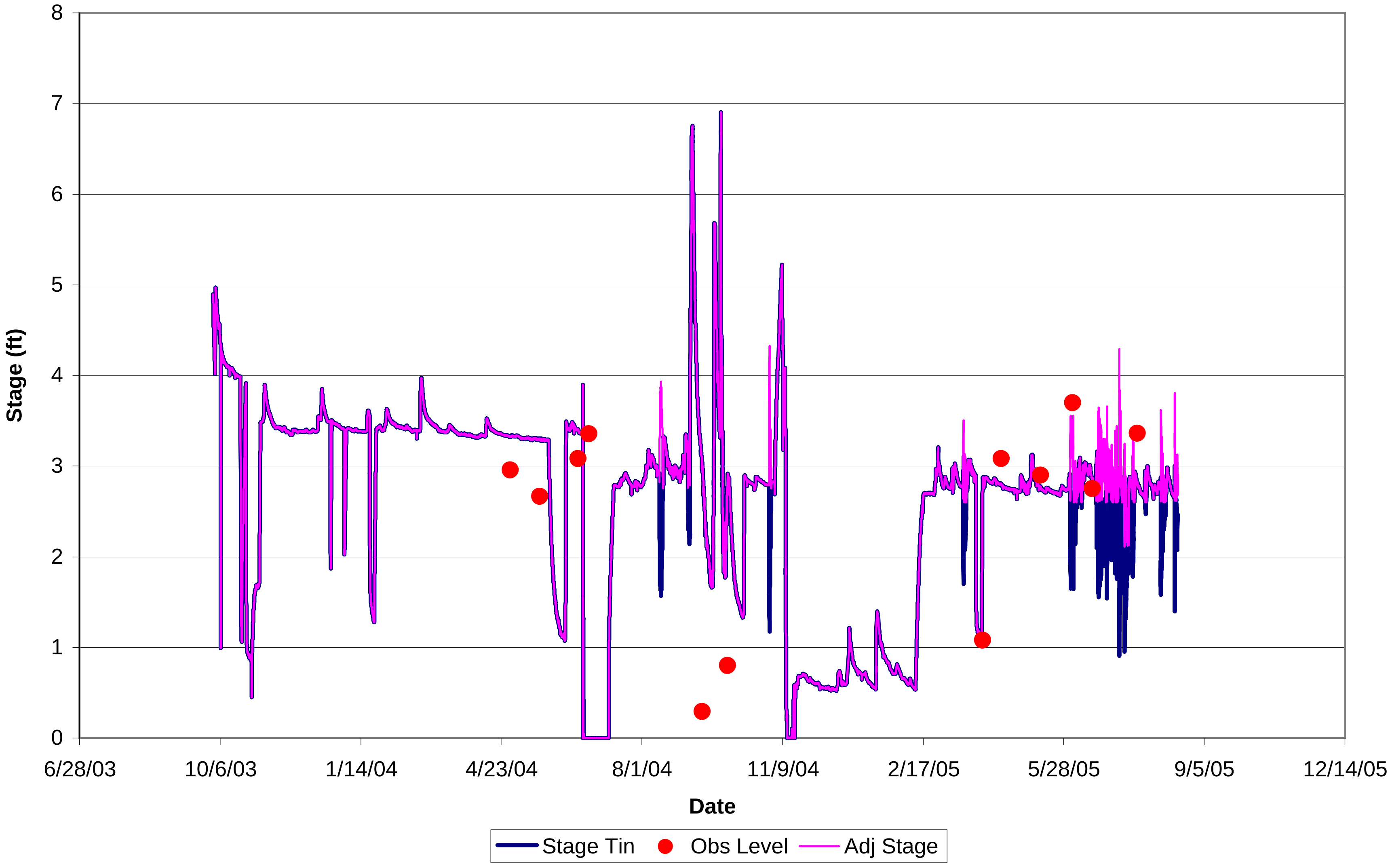


# APPENDIX B

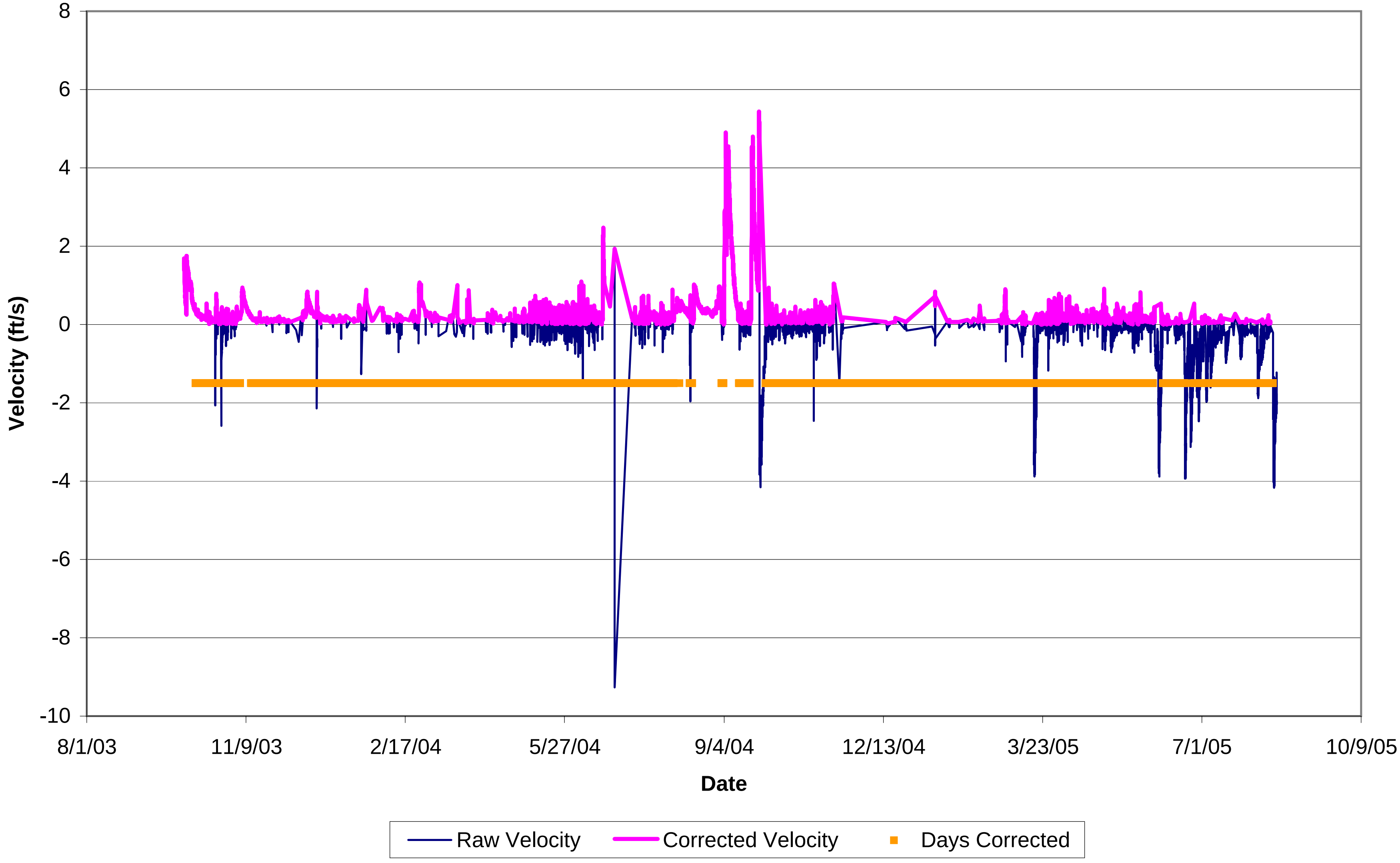
# FLOW AND WATER QUALITY DATA FOR MONITORING SITES

## List of Figures

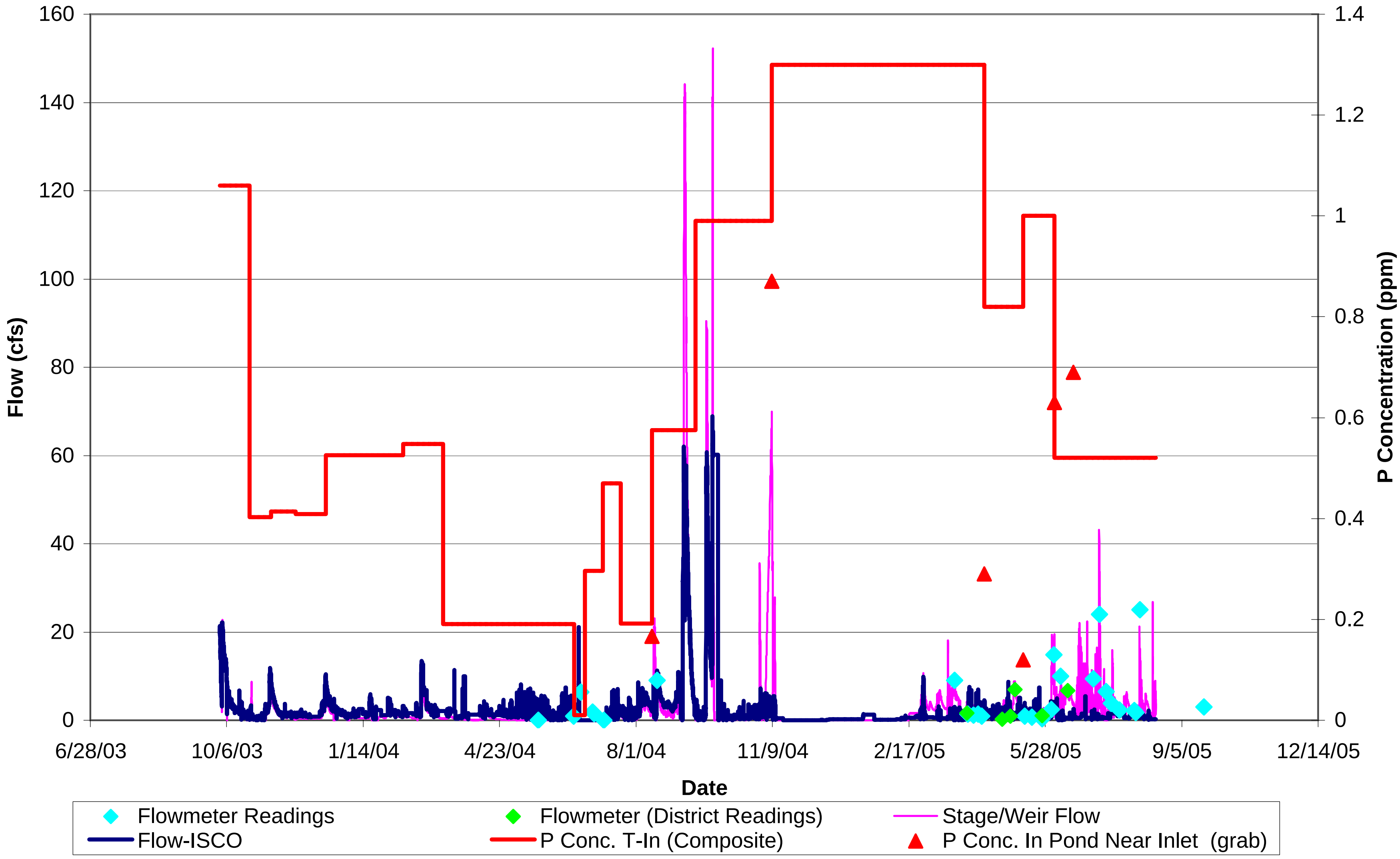
# Figure B-1.  Davie T-In - Stage



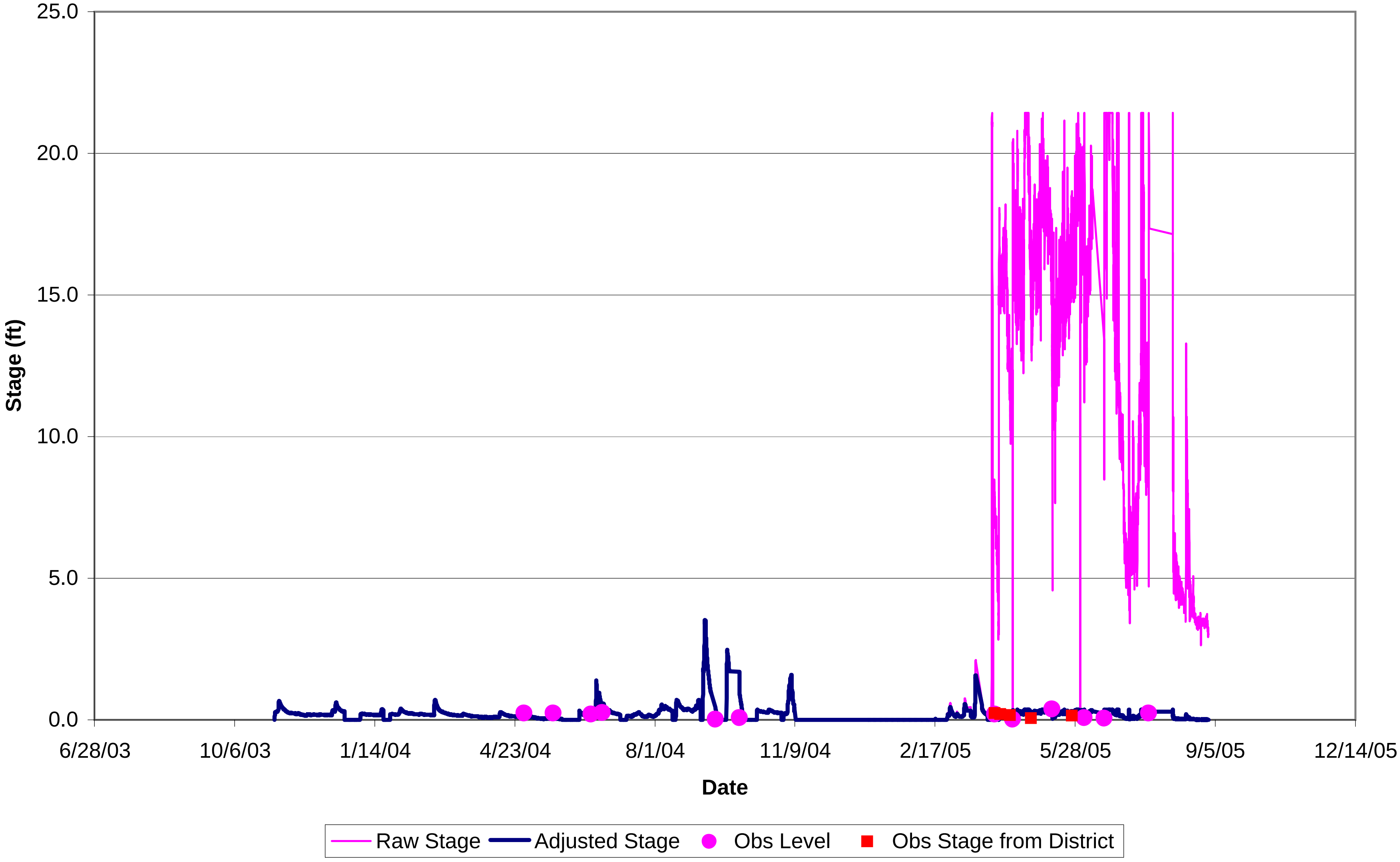
## Figure B-2.  Davie T-In - Velocity



## Figure B-3. Davie T-In - Flow and P Concentration



## Figure B-4. Davie T-Out - Stage



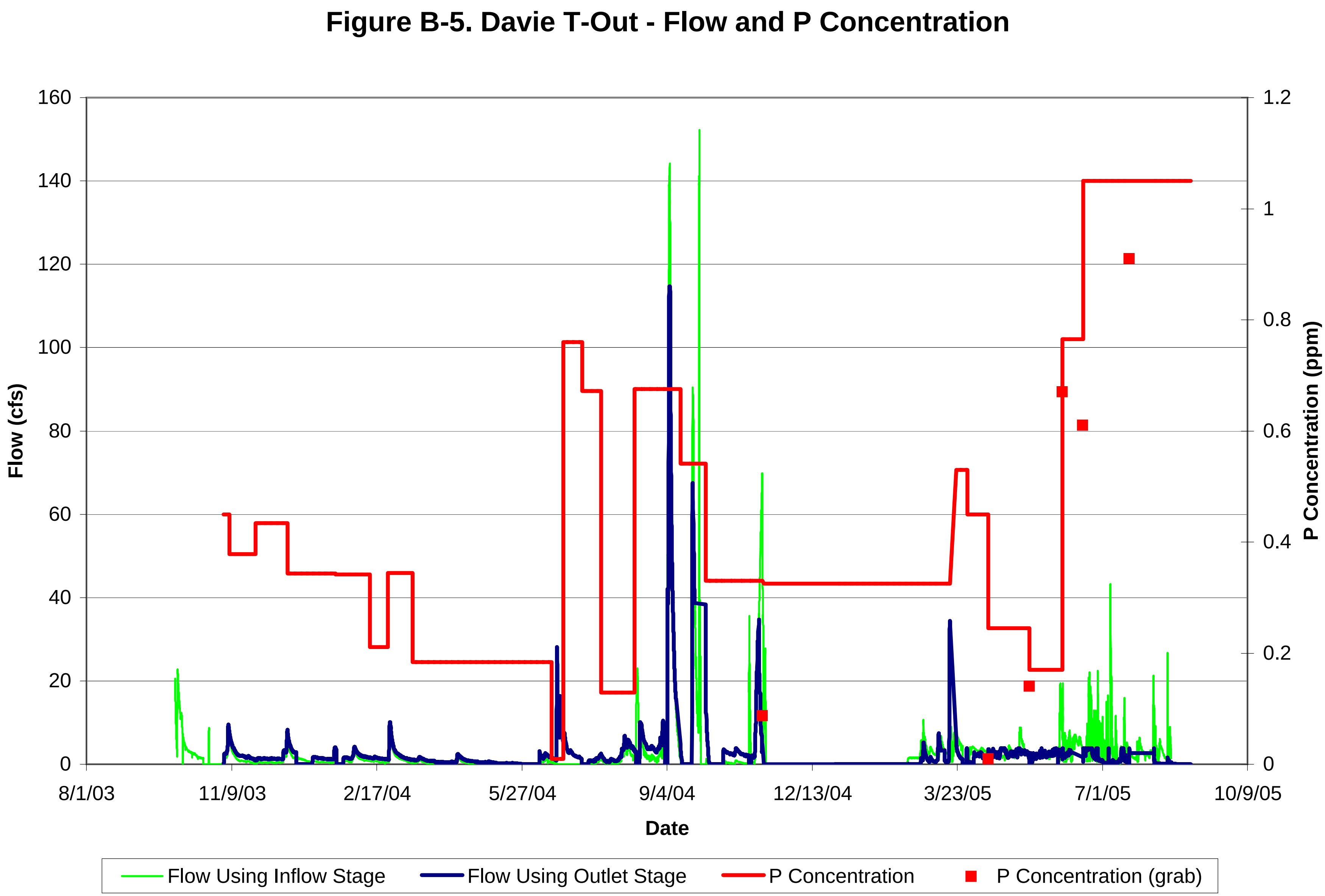
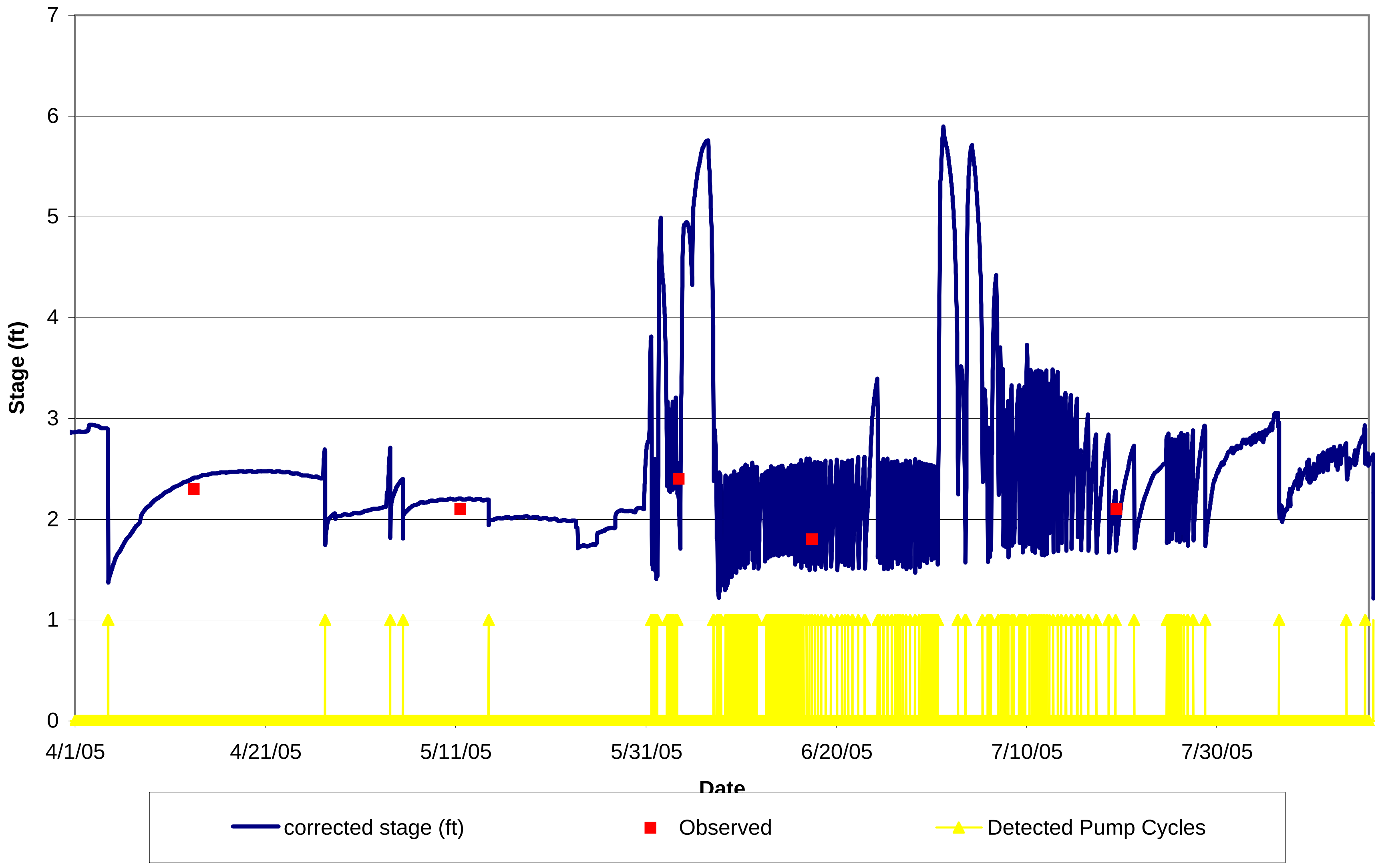


Figure B-5. Davie T-Out - Flow and P Concentration
Flow (cfs)
160
140
120
100
80
60
40
20
0
P Concentration (ppm)
1.2
1
0.8
0.6
0.4
0.2
0
8/1/03
11/9/03
2/17/04
5/27/04
9/4/04
12/13/04
3/23/05
7/1/05
10/9/05
Date
Flow Using Inflow Stage
Flow Using Outlet Stage
P Concentration
P Concentration (grab)

Figure B-6.   Butler T-In - Stage



## Figure B-8. Butler T-Out - Stage

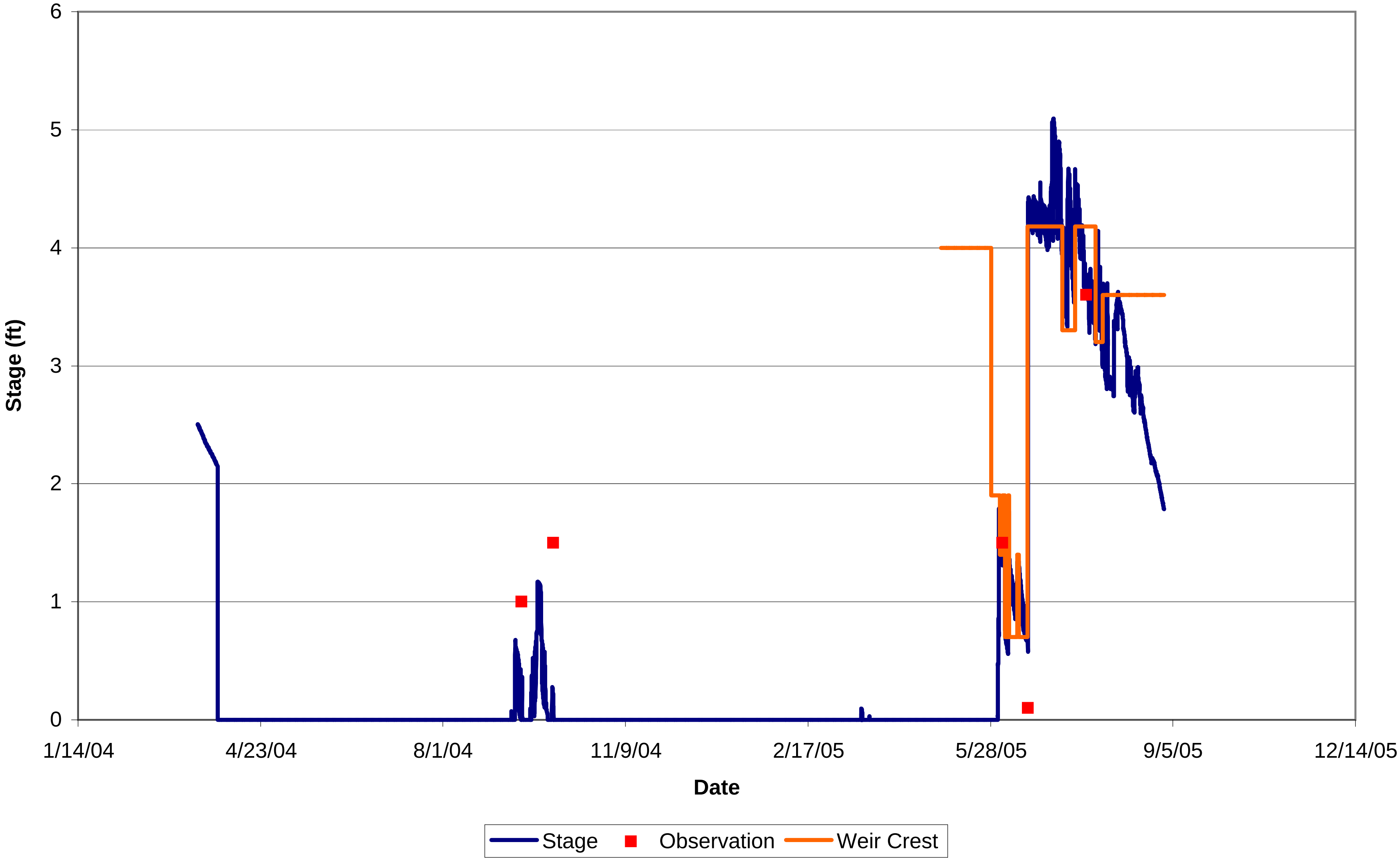
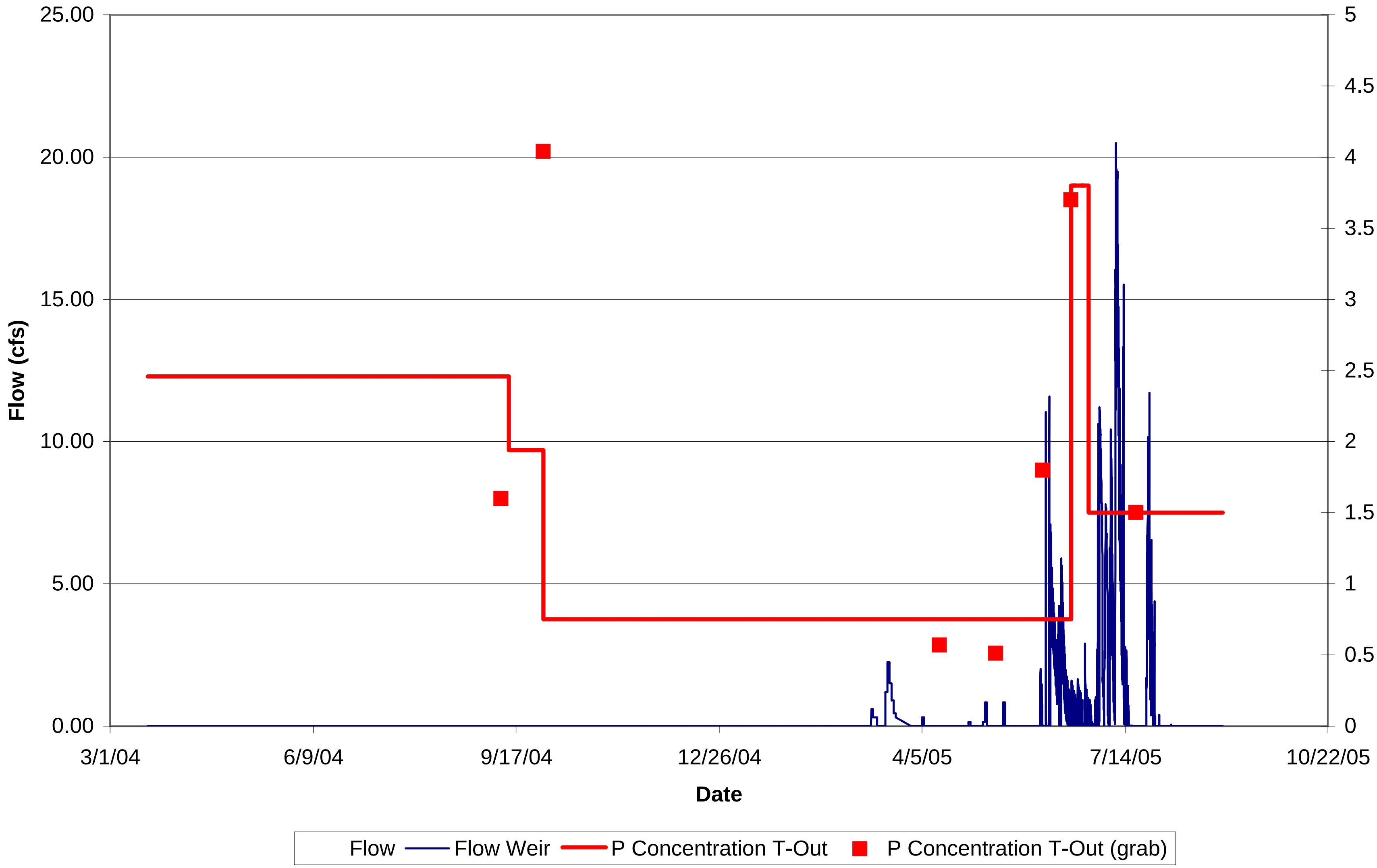
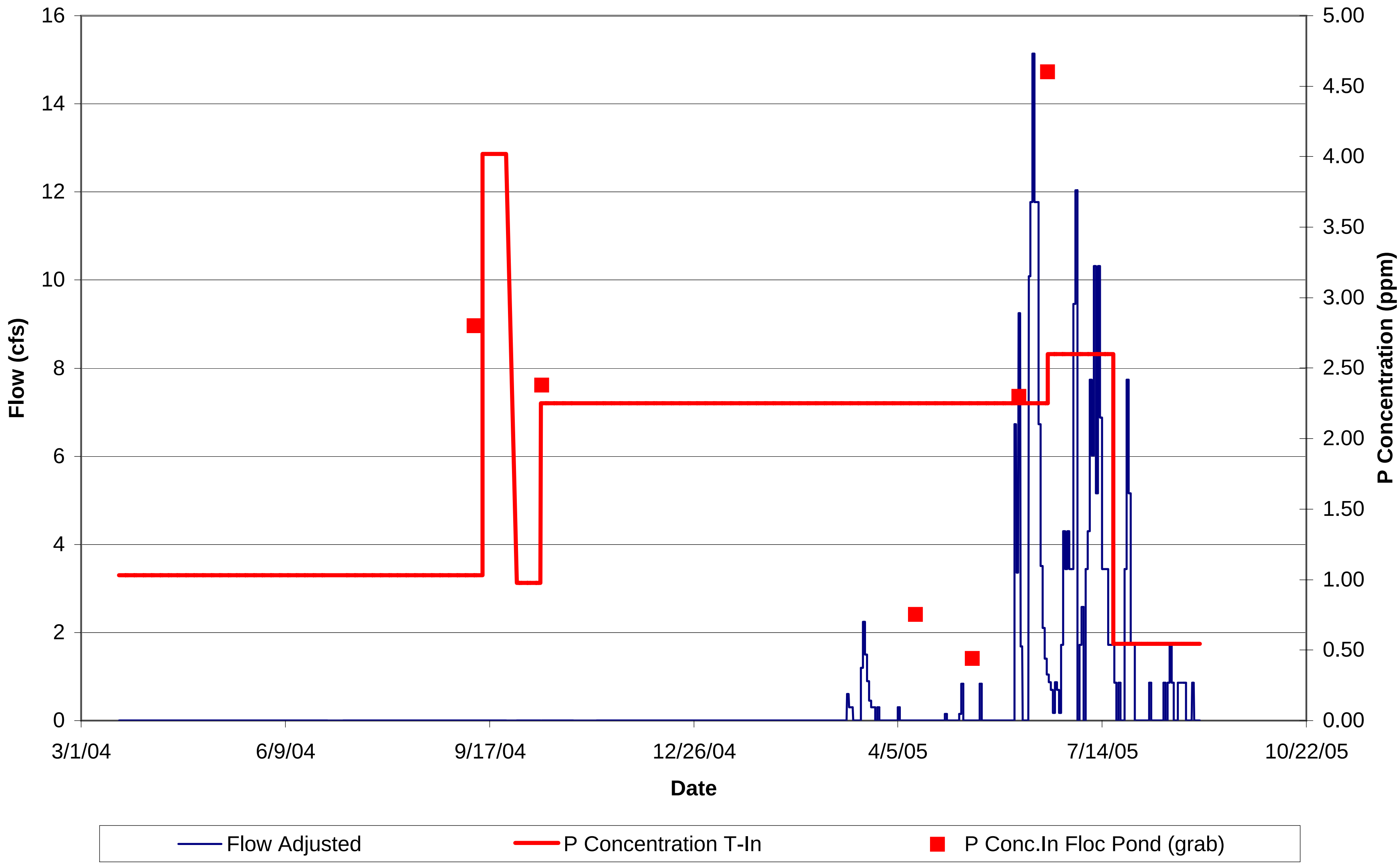


Figure B-9.   Butler T-Out - Flow and P Concentration



## Figure B-7 Butler T-In - Flow and P Concentration



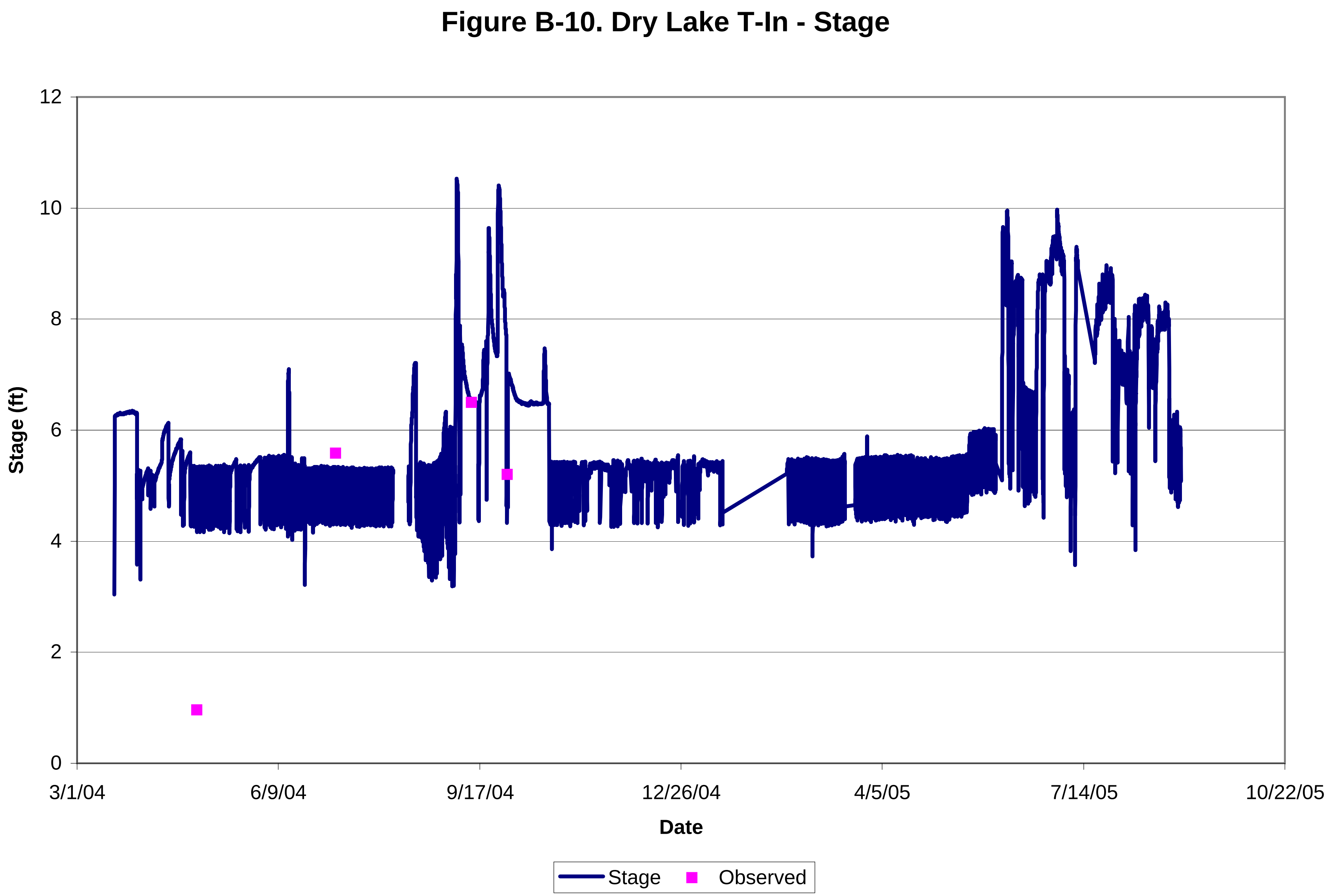
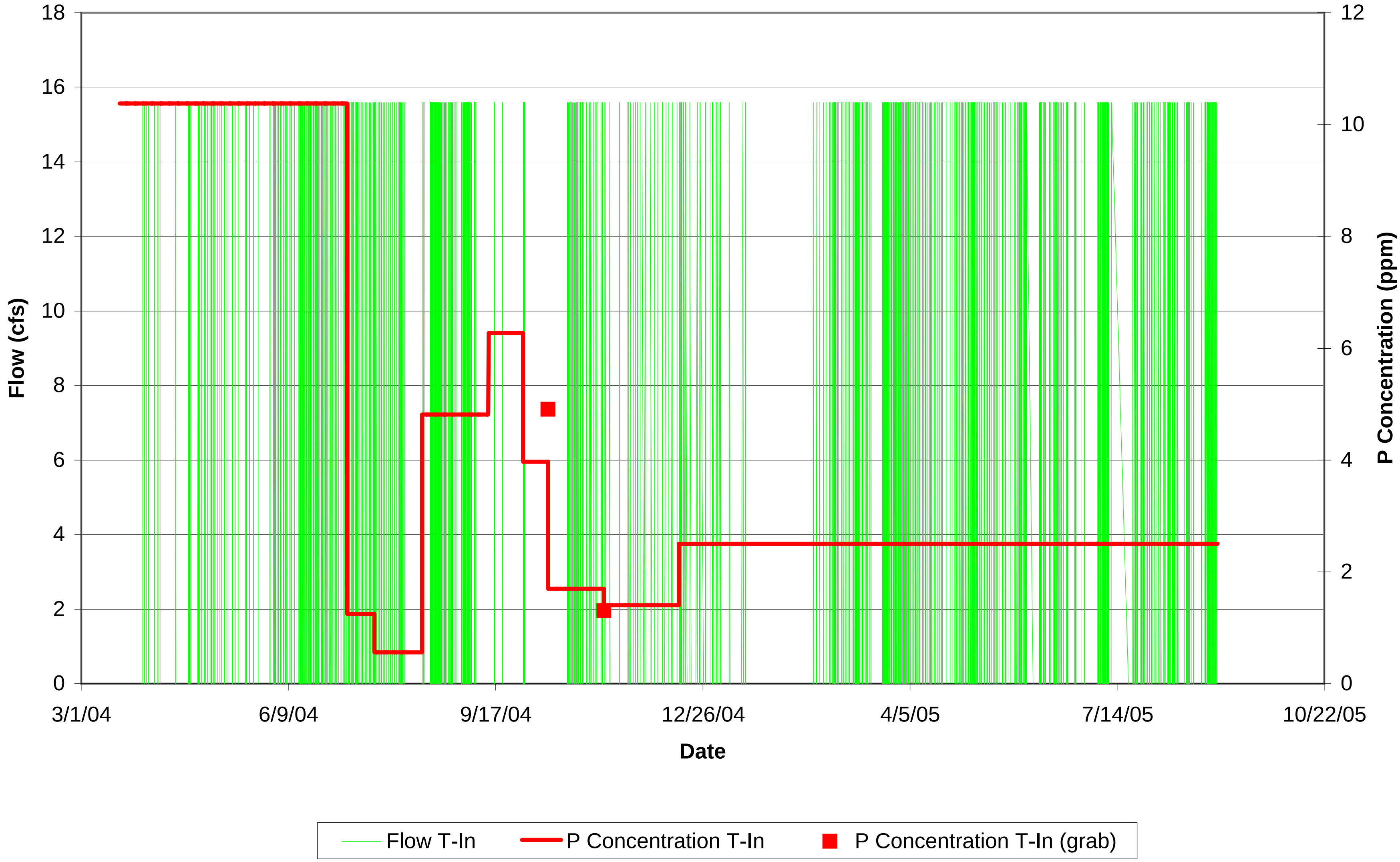


Figure B-10. Dry Lake T-In - Stage
Stage (ft)
12
10
8
6
4
2
0
3/1/04
6/9/04
9/17/04
12/26/04
4/5/05
7/14/05
10/22/05
Date
Stage
Observed

# Figure B-11.  Dry LakeT-In - Flow and P Concentration



## Figure B-12.  Dry Lake T-Mid - Stage

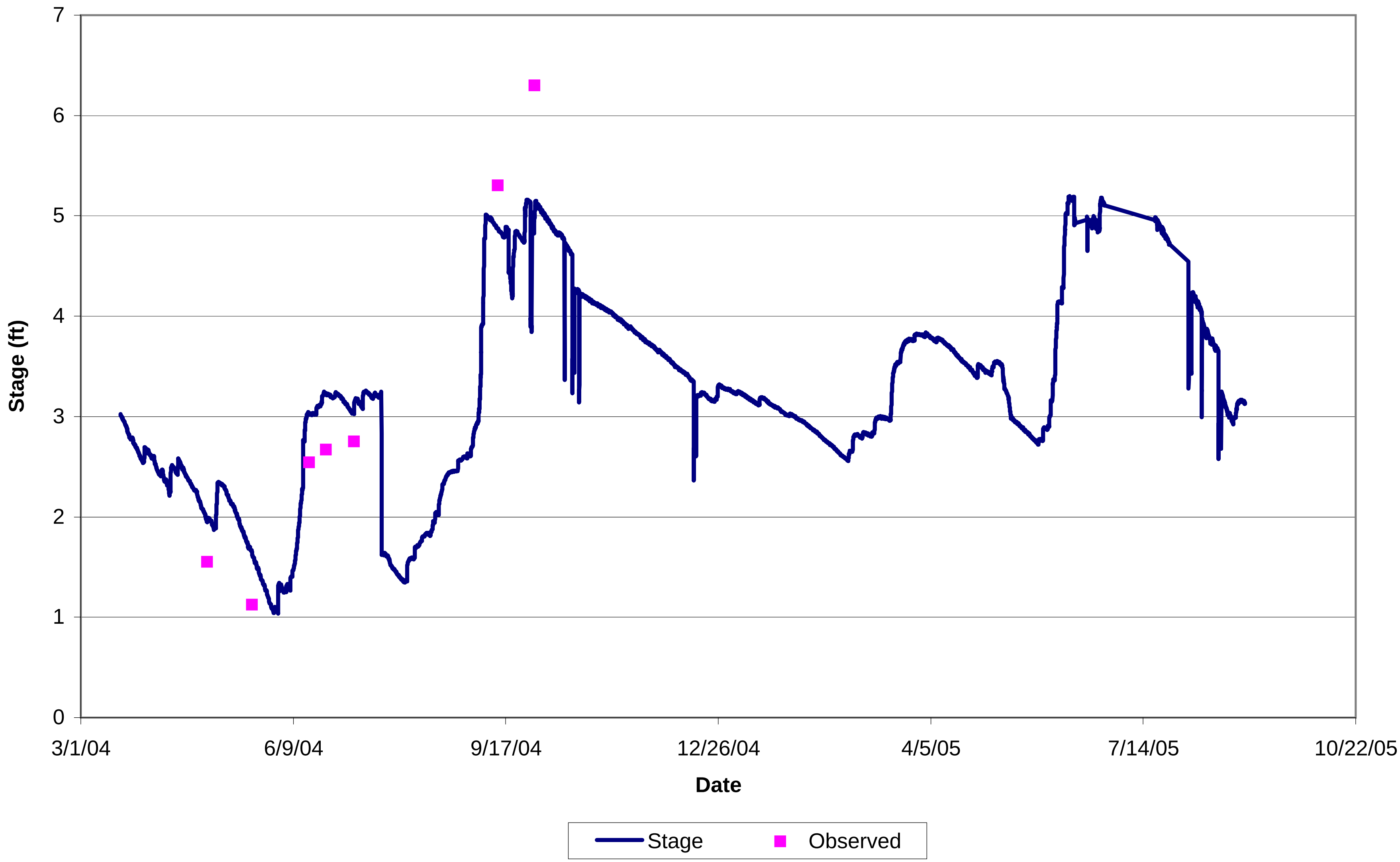
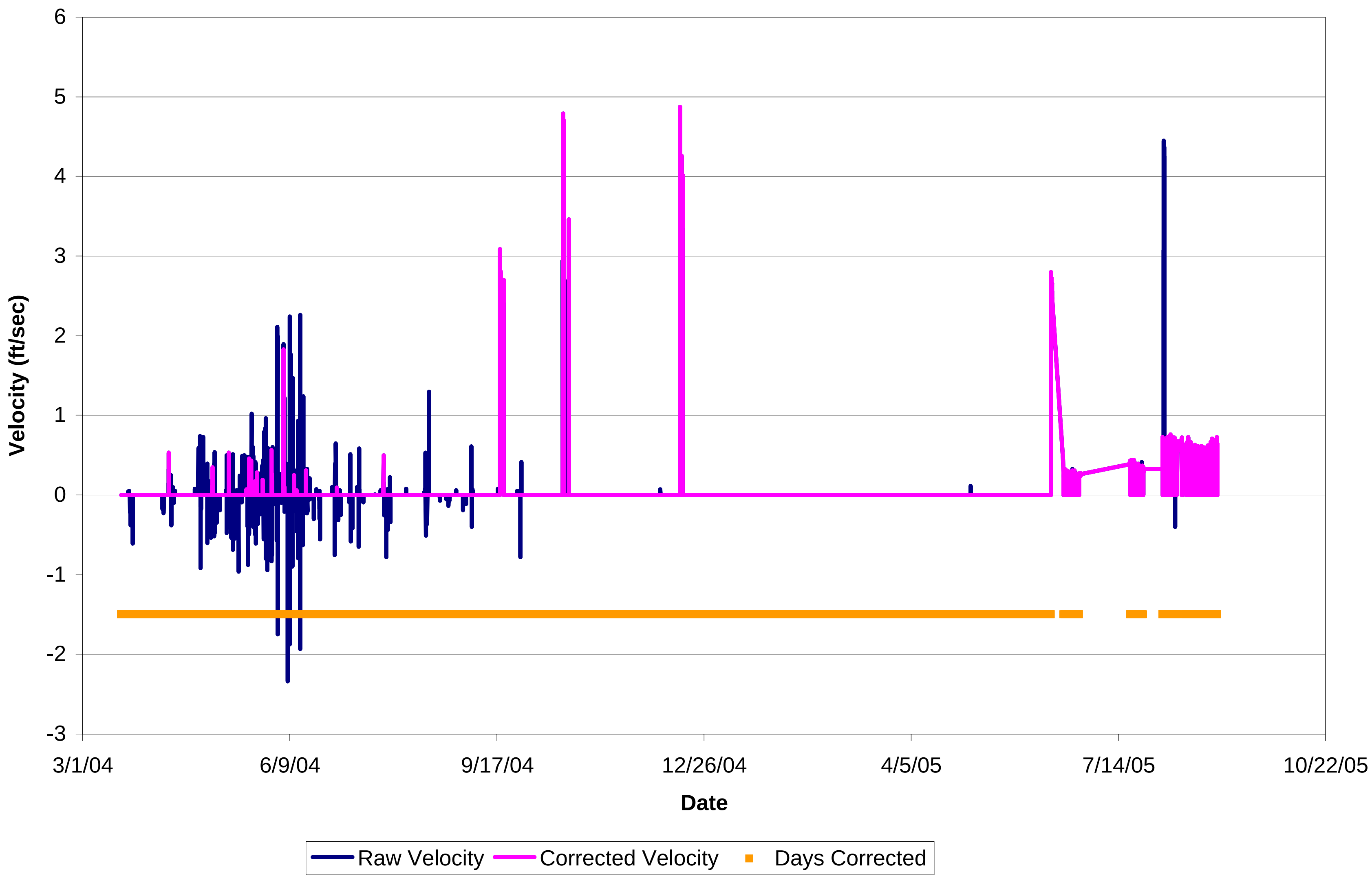


Figure B-13. Dry Lake T-Mid - Velocity



# Figure B-14.   Dry Lake T-Mid - Flow and P Concentration

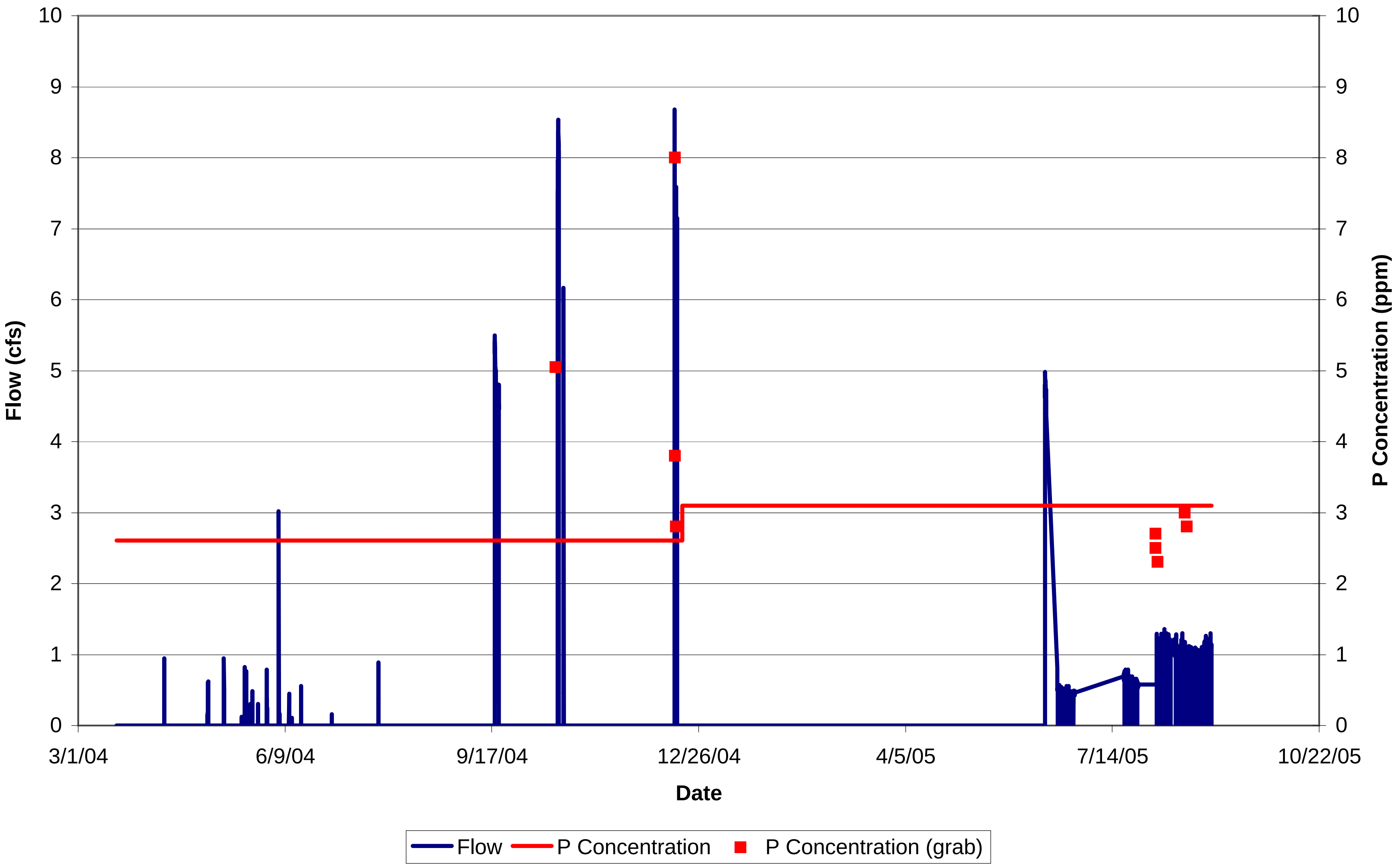
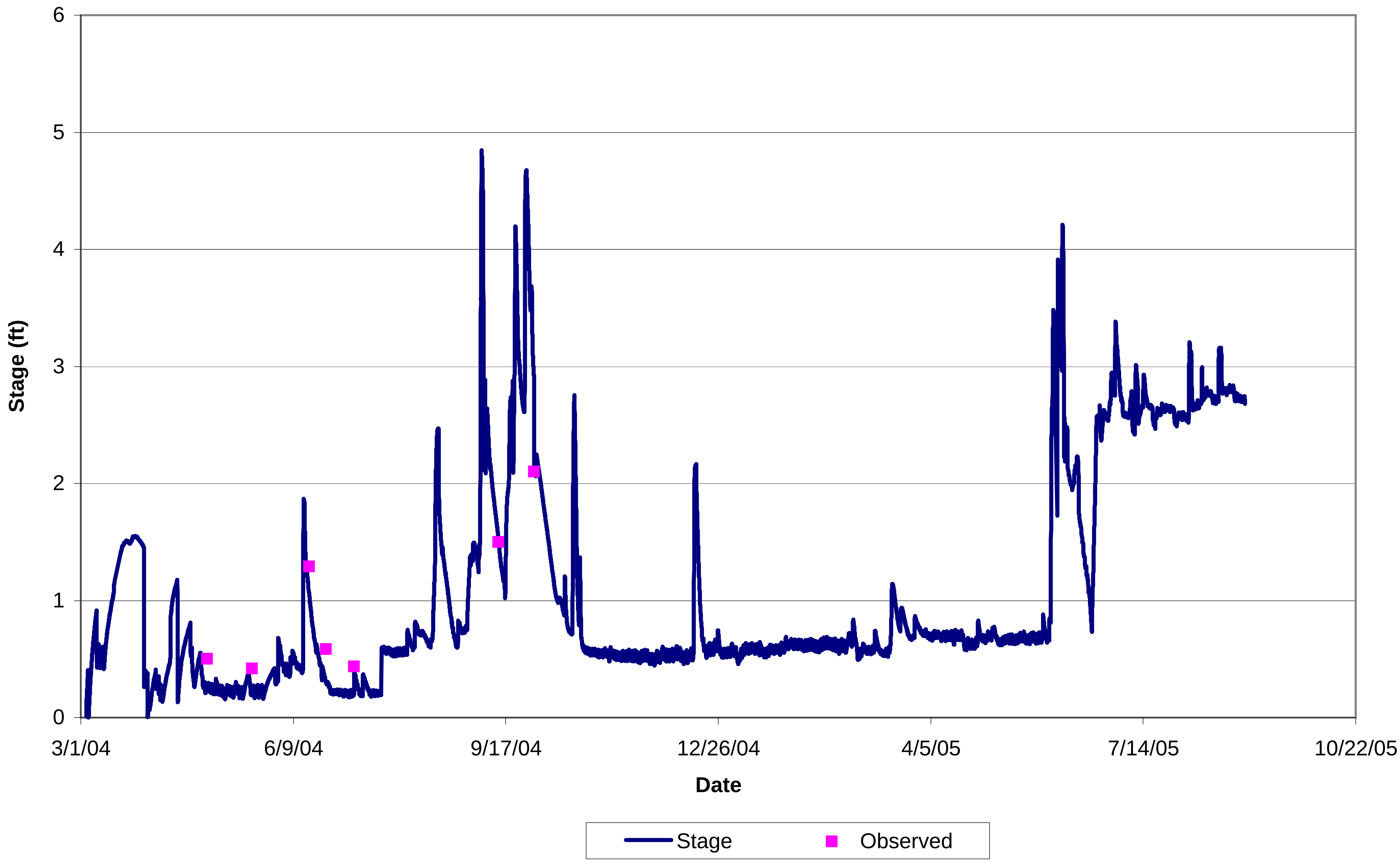


Figure B-15.  Dry Lake T-Out - Stage



## Figure B-16.  Dry Lake T-Out - Velocity

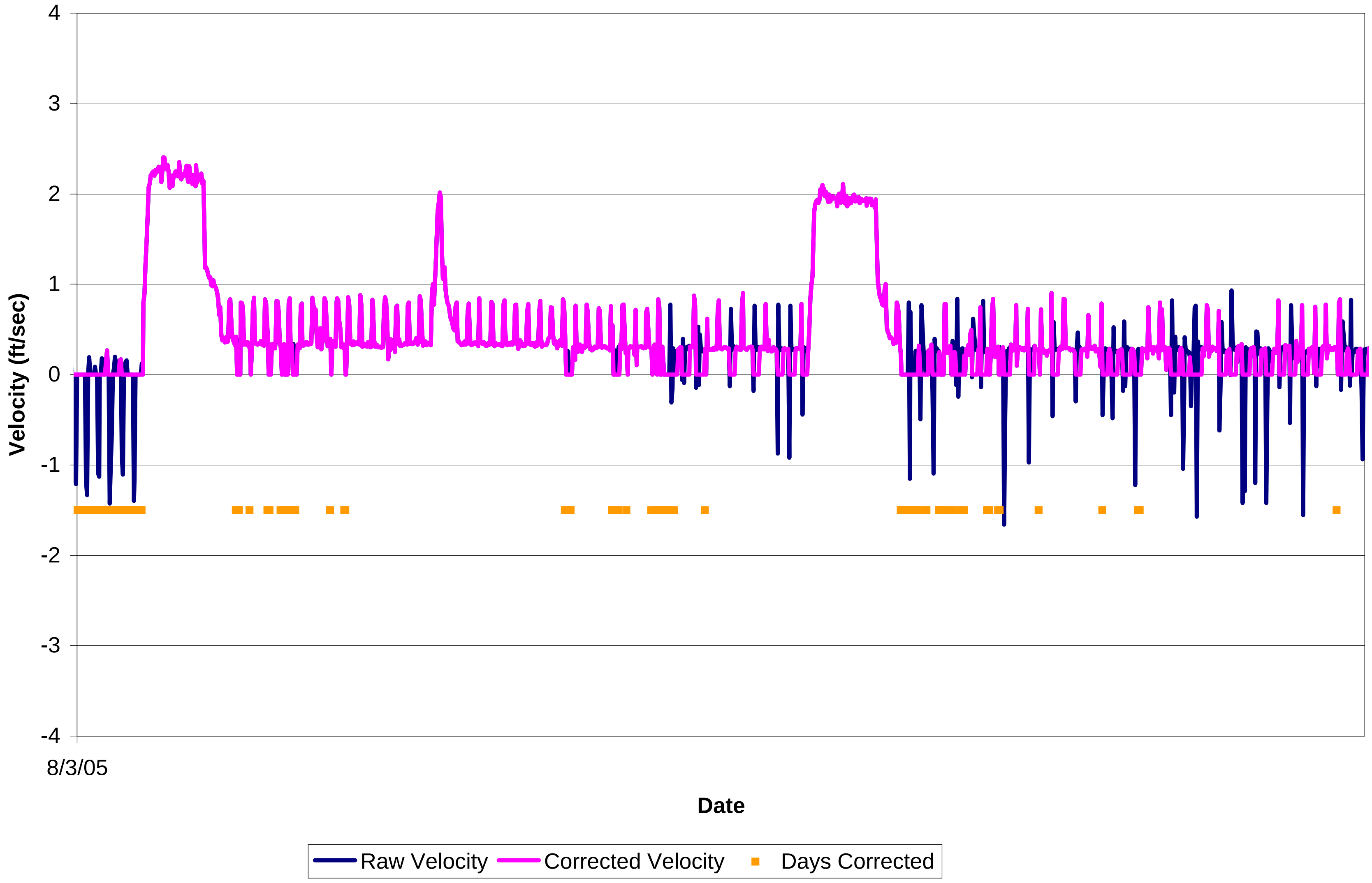


Figure B-17. Dry Lake T-Out - Flow and P Concentration

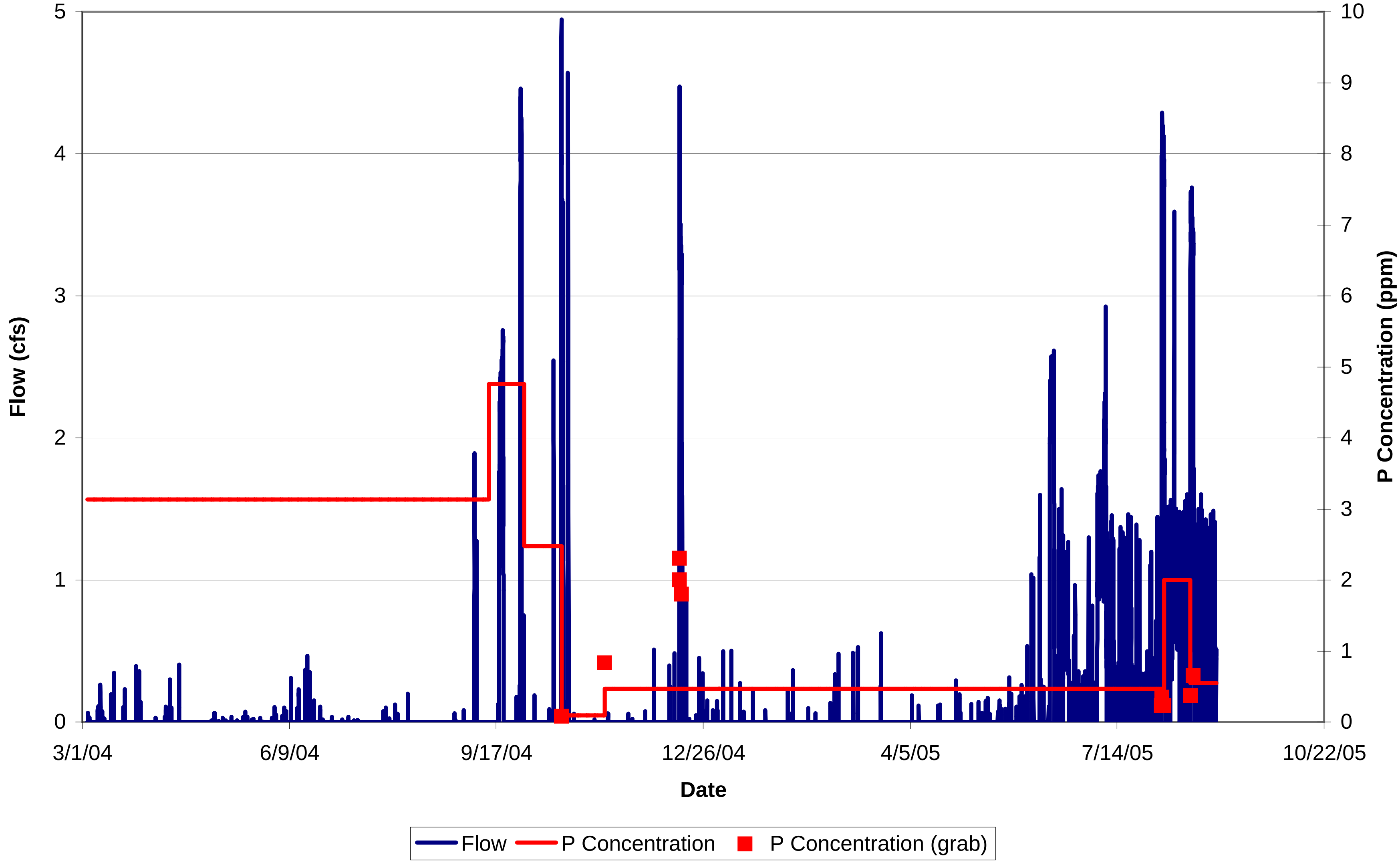


Figure B-18.  Collected Total Phosphorus Data for Davie System

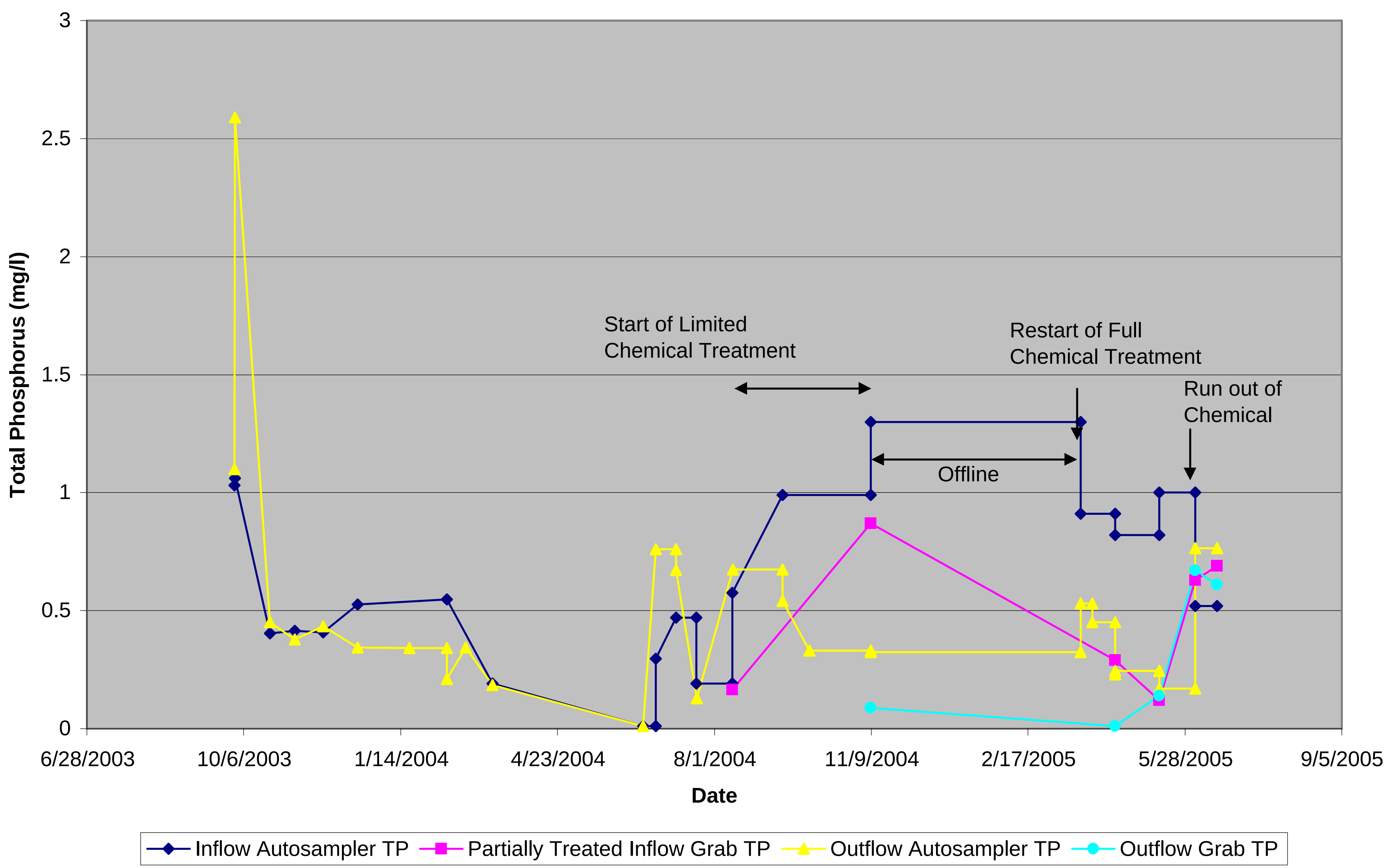


Figure B-19. Collected Total Phosphorus Data for Butler System

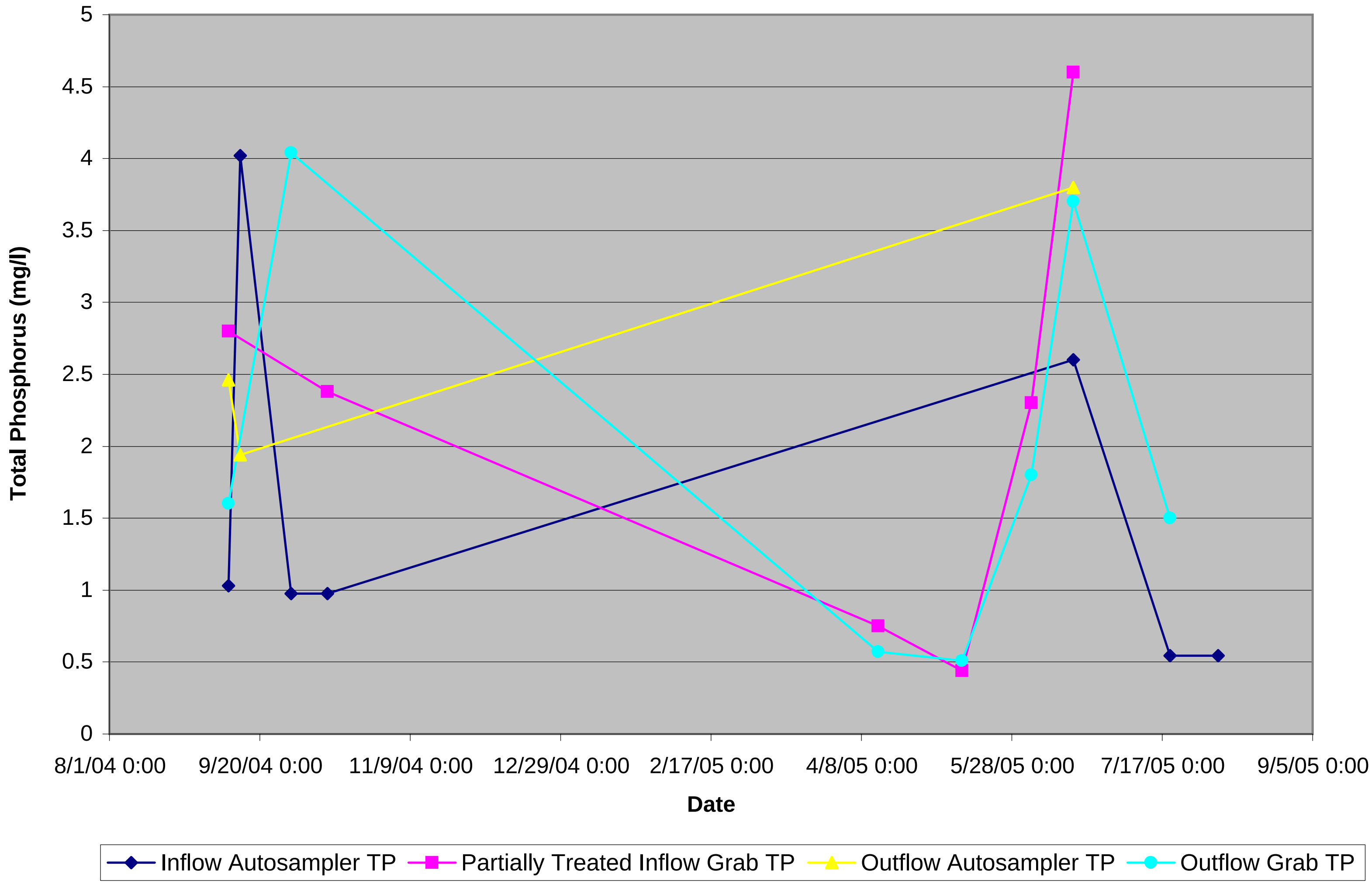


**Figure B-20. Collected Total Phosphorus Data for Dry Lake System**